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Scientific and Technical Aerospace Reports

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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The authority for the indexing vocabulary used in the subject index of this issue of *STAR* is the *NASA Thesaurus*. The most recent version is the *NASA Thesaurus—Alphabetical Update* (NASA SP-7040), September 1971, which is available from NTIS as accession number N72-15923 for $6.00 in paper copy. The current cross-reference structuring for each term appears in this volume, together with additional approved terms that may be used in indexing documents announced in other issues of *STAR*. NASA SP-7040 supersedes the first two volumes (subject terms A–Z) of the three-volume *Preliminary Edition of the NASA Thesaurus* (NASA SP-7030), December 1967. Volume III of the Preliminary Edition presented the following aids to vocabulary selection of the 1967 terms: hierarchical display of index terms, category terms listing, and permuted index; this has not been updated but may still be useful.

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Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc.; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

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32 Structural Mechanics 1462
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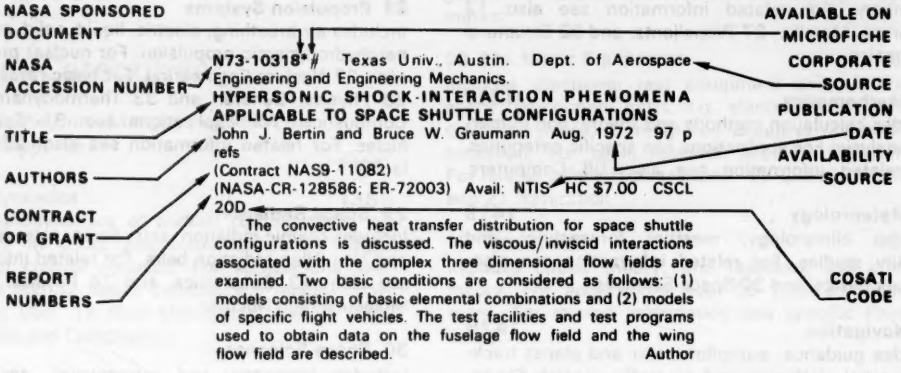
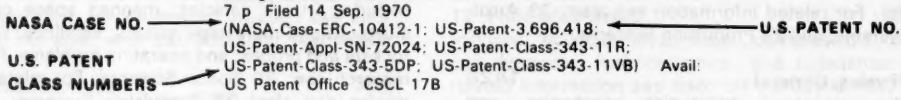


N73-10318*# Texas Univ., Austin. Dept. of Aerospace Engineering and Engineering Mechanics.
HYPERSONIC SHOCK-INTERACTION PHENOMENA APPLICABLE TO SPACE SHUTTLE CONFIGURATIONS
John J. Bertin and Bruce W. Graumann Aug. 1972 97 p refs
(Contract NAS9-11082)
(NASA-CR-128586; ER-72003) Avail: NTIS HC $7.00 CSCL 20D

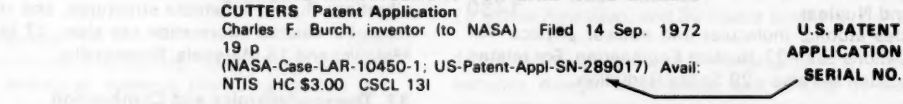
The convective heat transfer distribution for space shuttle configurations is discussed. The viscous/inviscid interactions associated with the complex three dimensional flow fields are examined. Two basic conditions are considered as follows: (1) models consisting of basic elemental combinations and (2) models of specific flight vehicles. The test facilities and test programs used to obtain data on the fuselage flow field and the wing flow field are described. Author

PATENT CITATION



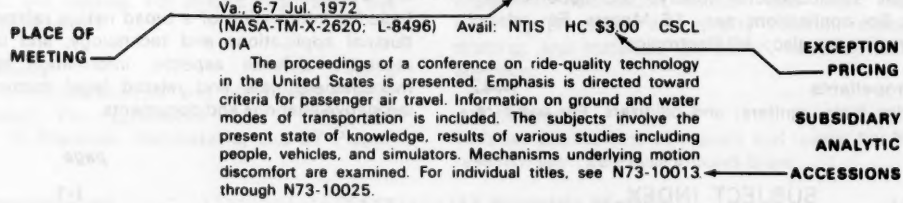
N73-12211* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
ALTITUDE MEASURING SYSTEM Patent
George B. Litchford, inventor (to NASA) Issued 3 Oct. 1972 7 p Filed 14 Sep. 1970
(NASA-Case-ERC-10412-1; US-Patent-3,696,418; US-Patent-Appl-SN-72024; US-Patent-Class-343-11R; US-Patent-Class-343-5DP; US-Patent-Class-343-11VB) Avail: US Patent Office CSCL 17B

PATENT APPLICATION CITATION



N73-10504*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
GRINDING ARRANGEMENT FOR BALL NOSE MILLING CUTTERS Patent Application
Charles F. Burch, inventor (to NASA) Filed 14 Sep. 1972 19 p
(NASA-Case-LAR-10450-1; US-Patent-Appl-SN-289017) Avail: NTIS HC $3.00 CSCL 13I

PRIMARY ANALYTIC CITATION AND ABSTRACT



N73-10012*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SYMPOSIUM ON VEHICLE RIDE QUALITY
Washington Oct. 1972 256 p refs Symp. held at Hampton, Va., 6-7 Jul. 1972
(NASA-TM-X-2620; L-8496) Avail: NTIS HC $3.00 CSCL 01A

The proceedings of a conference on ride-quality technology in the United States is presented. Emphasis is directed toward criteria for passenger air travel. Information on ground and water modes of transportation is included. The subjects involve the present state of knowledge, results of various studies including people, vehicles, and simulators. Mechanisms underlying motion discomfort are examined. For individual titles, see N73-10013 through N73-10025.

SUBSIDIARY ANALYTIC CITATION

N73-10014* Douglas Aircraft Co., Inc., Long Beach, Calif.
AN AIRCRAFT MANUFACTURER'S APPROACH TO RIDEABILITY CRITERIA
R. C. OMassey, H. Leve, and J. G. Gaume *In* NASA. Langley Res. Center Symp. on Vehicle Ride Quality Oct. 1972 p 23-49 refs (For availability see N73-10012 01-02) CSCL 01A

VOLUME 11 NUMBER 12 / JUNE 23, 1973

Scientific and Technical Aerospace Reports

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01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbomachinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N73-20995 Mississippi State Univ., State College.
AN ANALYSIS OF THE DESIGN OF AIRFOIL SECTIONS FOR LOW REYNOLDS NUMBERS Ph.D. Thesis
Stanley Jay Miley 1972 198 p
Avail: Univ. Microfilms Order No. 72-20272

A theoretical investigation of the influences of low Reynolds numbers on the design of airfoil sections has been performed. The airfoil design philosophy instituted by Wortmann and the mathematical design tools developed by Eppler served as a foundation for the study. All theoretical methods employed were done so only after their use could be justified on the basis of demonstrable validity in the physical reality. In particular, boundary layer transition criteria and turbulent flow prediction methods were subjected to a comparative study. Based on the requirement to achieve transition upstream of a major adverse pressure gradient, the results of the theoretical investigation demonstrate that as the Reynolds number is progressively lowered below 4 times one million, to obtain a practical operating range of lift coefficients, one becomes more and more restricted to reflex profiles whose lower surfaces contain pressure gradients which can be supported only by a laminar boundary layer.
Dissert. Abstr.

N73-20996 Illinois Univ., Urbana.
THE DETERMINATION OF THE GEOMETRIES OF MULTIPLE ELEMENT AIRFOILS OPTIMIZED FOR MAXIMUM LIFT COEFFICIENT Ph.D. Thesis
Allen Wen-shin Chen 1972 97 p
Avail: Univ. Microfilms Order No. 72-19807

Optimum airfoils in the sense of maximum lift coefficient are obtained. The maximum lift coefficient is achieved by requiring that the turbulent skin friction be zero in the pressure rise region on the upper surface. Under this constraint, the pressure distribution is optimized. The optimum pressure distribution consists of a uniform stagnation pressure on the lower surface, a uniform minimum pressure on the upper surface immediately downstream of the front stagnation point followed by a Stratford zero skin friction pressure rise. When multiple-element airfoils are under consideration, this optimum pressure distribution appears on every element. The parameters used to specify the pressure distribution on each element are the Reynolds number and the normalized trailing edge velocity.
Dissert. Abstr.

N73-20997*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
RESULTS OF FULL-SCALE WIND TUNNEL TESTS ON THE H.126 JET FLAP AIRCRAFT
Thomas N. Aiken and Anthony M. Cook Washington Apr. 1973 66 p refs
(NASA-TN-D-7252; A-3611) Avail: NTIS HC $3.00 CSCL 20D

The aerodynamic characteristics of the full-scale H.126 jet flap aircraft were studied in a 40- by 80-foot wind tunnel. The H.126 aircraft is designed for research on flight characteristics of an aircraft using the jet flap principle. Static longitudinal, lateral, and directional characteristics were measured at a Reynolds number of 2.5 to 2.7 million. The jet control power as well as the aerodynamic characteristics were measured and are presented herein with limited discussion. The primary configuration variables were flap and aileron deflection.
Author

N73-20998*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A METHOD FOR ESTIMATING STATIC AERODYNAMIC CHARACTERISTICS FOR SLENDER BODIES OF CIRCULAR AND NONCIRCULAR CROSS SECTION ALONE AND WITH LIFTING SURFACES AT ANGLES OF ATTACK FROM 0 DEG TO 90 DEG
Leland H. Jorgensen Washington Apr. 1973 38 p refs
(NASA-TN-D-7228; A-4700) Avail: NTIS HC $3.00 CSCL 01A

An engineering-type method is presented for estimating normal-force, axial-force, and pitching-moment coefficients for slender bodies of circular and noncircular cross section alone and with lifting surfaces. Static aerodynamic characteristics computed by the method are shown to agree closely with experimental results for slender bodies of circular and elliptic cross section and for winged-circular and winged-elliptic cones. However, the present experimental results used for comparison with the method are limited to angles of attack only up to about 20 deg and Mach numbers from 2 to 4.
Author

N73-20999# Aircraft Research Association, Ltd., Bedford (England).
A COMPARISON OF WING PRESSURE DISTRIBUTIONS MEASURED IN FLIGHT AND ON A WIND TUNNEL MODEL OF THE SUPER VC 10
G. C. Browne, T. E. B. Bateman, M. Pavitt, and A. B. Haines London Aeron. Res. Council 1972 71 p refs Supersedes ARC-33317
(ARC-R/M-3707; ARC-33317) Avail: NTIS HC $5.75; HMSO £2.50; PHI $9.80

Pressure distributions measured in flight for ten M_i in the range from M = 0.70 to 0.88 are compared with corresponding results from tunnel tests at a Reynolds number of 5.4 x 10 to the 6th power. In all these conditions the flow over the wing upper surface was supercritical. The scale effect is small but measurable, the shock wave tending to be slightly further aft in flight by up to about 0.05 c. Three other discrepancies between flight and tunnel results are: the suction level ahead of the shock over part of the span is somewhat lower in flight; there is a tendency for the shock-induced separation to extend to the trailing edge earlier in flight; and there are detailed differences in the flow through and behind the forward shock wave near the wing root. The first two of these effects are shown to be at least partly due to the presence on the aircraft wing surface of the external

tubing used for measuring pressures. In general, apart from these particular differences, there is good agreement between the flight and tunnel pressure distributions. Author (ESRO)

N73-21000# Royal Aircraft Establishment, Farnborough (England). Structures Dept.
A REVIEW OF COMPARATIVE THEORETICAL AND EXPERIMENTAL AERODYNAMIC DATA RELEVANT TO ZERO- AND LOW-FREQUENCY AEROELASTIC PROBLEMS
A. S. Taylor London Aeron. Res. Council 1972 51 p refs Supersedes RAE-TR-70089; ARC-32451
(ARC-R/M-3708; RAE-TR-70089; ARC-32451) Avail: NTIS HC $4.75; HMSO £1.90; PHI $7.65

Resumes of the contents of reports which give comparative theoretical and experimental aerodynamic loading data and, in some cases, structural deformation data, relevant to zero- and low-frequency aeroelastic problems are provided in tabular form. There is a broad classification of reports according to whether data have been obtained from tests on nominally rigid models with built-in warp or from tests on flexible models or full-scale aircraft. Details of reports which contain only experimental data are also tabulated. From an analysis of the data it is concluded that, in the limited range for which the flow is attached and the flow field is wholly subsonic or supersonic, theoretical methods can provide estimates of aeroelastic distortion effects which are adequate for engineering purposes, but that there is an urgent need to develop theoretical and/or empirical methods of estimating such effects for important design cases which occur outside this restricted flow regime. Author (ESRO)

N73-21001# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Aerodynamik.
CALCULATION OF THE FRICTION EFFECT ON THE LIFT OF AN AIRFOIL SECTION WITH SLOTTED FLAP [BERECHNUNG DES REIBUNGSEINFLUSSES AUF DEN AUFTRIEB EINES SPALTKLAPPENPROFILS]
Johannes Steinheuer 1973 42 p refs In GERMAN; ENGLISH summary
(DLR-FB-73-04) Avail: NTIS HC $4.25; DFVLR, Porz, West Ger. 11 DM

A method is presented for the determination of the lift of a slotted flap airfoil profile by purely computational means. The method is based on existing procedures for the solution of the inviscid potential-flow problem and for the calculation of the boundary layer development. The validity of a new relation between the reduction of lift and the skin friction coefficient has been ascertained by comparison with measurements for a single airfoil. The optimal flap position as determined by the calculations agrees very well with experimental results. Further numerical examples show that the method predicts the effect of variation in Reynolds number in the right sense. Author (ESRO)

N73-21002# Northrop Corp., Hawthorne, Calif. Aircraft Div.
THE CALCULATION OF THREE-DIMENSIONAL SUPERSONIC FLOWS AROUND SPHERICALLY-CAPPED SMOOTH BODIES AND WINGS. VOLUME 2: MANUAL FOR COMPUTER PROGRAMS Final Report, 1 Dec. 1971 - 3 Jul. 1972
Chong-Wei Chu and Sidney A. Powers Sep. 1972 207 p
(Contract F33615-72-C-1429; AF Proj. 1366)
(AD-753696; NOR-72-87-Vol-2; AFFDL-TR-72-91-Vol-2) Avail: NTIS CSCL 20/4

The report describes the theories, the numerical methods and the computer programs developed for determining the inviscid three-dimensional flow about smooth shapes at supersonic speeds. Volume II is a user's manual for the computer programs and provides the detailed information needed to set up and use the programs. These programs can determine the supersonic flow past smooth blunted bodies for any angle of attack for which the initial value surface remains on the blunted nose. The lowest usable Mach number is on the order of 2.0, with lower values attainable by careful attention to the initial value surface solution. There is no computational upper limit on the Mach number. Author (GRA)

N73-21041* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A SUMMARY OF CURRENT RESEARCH IN ROTOR UNSTEADY AERODYNAMICS WITH EMPHASIS ON WORK AT LANGLEY RESEARCH CENTER
John F. Ward and Warren H. Young, Jr. *In* AGARD Aerodyn. of Rotary Wings Feb. 1973 20 p refs Prepared in cooperation with Army Air Mobility R and D Lab., Fort Eustis, Va. (For availability see N73-21031 12-02)

N73-21042 Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
AERODYNAMIC FORCES COMPUTATION AND MEASUREMENT ON AN OSCILLATING AEROFOIL PROFILE WITH AND WITHOUT STALL
J. J. Philippe and M. Sagner *In* AGARD Aerodyn. of Rotary Wings Feb. 1973 13 p refs In FRENCH; ENGLISH summary (For availability see N73-21031 12-02)

N73-21054 Bogazici Univ., Istanbul (Turkey).
WAKE CHARACTERISTICS OF A TWO DIMENSIONAL ASYMMETRIC AEROFOIL
Ibrahim Kavrak *In* AGARD Aerodyn. Rotary Wings Feb. 1973 7 p refs (For availability see N73-21031 12-02)

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N73-21003 Case Western Reserve Univ., Cleveland, Ohio.
AUTOMATED OPTIMUM DESIGN OF AIRCRAFT WINGS TO SATISFY STRENGTH, STABILITY, FREQUENCY AND FLUTTER REQUIREMENTS Ph.D. Thesis
Singiresu Sambasiva Rao 1972 270 p
Avail: Univ. Microfilms Order No. 72-18728

The optimum design of complex structures to satisfy strength, stability, frequency and flutter requirements is considered. More specifically, the minimum weight design of supersonic aircraft wing structures with finite element modeling is considered for this exploratory study. The wing is assumed to fly through a series of flight conditions with different fuel configurations while supporting a specified payload. The restrictions imposed upon the behavior of the structure involve limitations on displacements, stresses, flutter Mach numbers and the range in which the natural frequencies are allowed to fall. Elastic buckling constraints are introduced by treating a typical portion of the wing skin as an isotropic stiffened plate. The constant stress triangular plate elements, the rectangular shear panels and the pin-jointed bar elements are used to idealize the multiweb wing structure. Dissert. Abstr.

N73-21004 Virginia Polytechnic Inst. and State Univ., Blacksburg.
ANALYTICAL INVESTIGATION OF THE TILT ROTOR WHIRL INSTABILITY Ph.D. Thesis
James Scheiman 1972 251 p
Avail: Univ. Microfilms Order No. 72-20413

A generalized analytical study of the whirl instability of a rotating propeller or rotor system is presented. The mathematical model consists of rigid members with three degrees-of-freedom at the wing root and the wing-drive-shaft joints. In addition, each blade has lagging and flapping freedom. Two dimensional aerodynamics, including compressibility and stall effects, are included. Whirl stability boundaries and characteristics are presented. The parameters investigated include both mechanical and operating variations such as shaft stiffness, number of blades and air density. It was found that decreasing forward speed can result in a whirl instability when blade stall is taken into account. No condition was found in which the rotor went into a forward precessional mode of motion. Dissert. Abstr.

N73-21005 Illinois Univ., Urbana.
AN AUTOMATED PROCEDURE FOR THE OPTIMIZATION OF AEROSPACE STRUCTURES Ph.D. Thesis
Walter Joseph Dwyer 1972 172 p
Avail: Univ. Microfilms Order No. 72-19821

The development of a new structural optimization algorithm, which is a combination of a modified fully stressed design technique and a redesign procedure based on gradients to deflection constraint surfaces, is discussed. The algorithm is incorporated into a large finite element program based on the displacement method of a structural analysis. Using an IBM 360/75 computer, the program is capable of obtaining optimum distributions of material for structural idealizations consisting of up to three thousand elements and six thousand degrees of freedom, and subjected to a maximum of twenty loading conditions. Constraints may be placed on the maximum and minimum size of any of the elements, on the stresses in the elements, and on the displacements of the nodal points of the structure. Dissert. Abstr.

N73-21006*# Michigan Univ., Ann Arbor.
STRUCTURAL MODELING OF AIRCRAFT TIRES
S. K. Clark, R. N. Dodge, J. I. Lackey, and G. H. Nybakken
Washington NASA Mar. 1973 81 p refs Revised
(Grant NGL-23-005-010)
(NASA-CR-2220; Rept-05608-16-T-Rev) Avail: NTIS HC $3.00 CSCL 01B

A theoretical and experimental investigation of the feasibility of determining the mechanical properties of aircraft tires from small-scale model tires was accomplished. The theoretical results indicate that the macroscopic static and dynamic mechanical properties of aircraft tires can be accurately determined from the scale model tires although the microscopic and thermal properties of aircraft tires can not. The experimental investigation was conducted on a scale model of a 40 x 12, 14 ply rated, type 7 aircraft tire with a scaling factor of 8.65. The experimental results indicate that the scale model tire exhibited the same static mechanical properties as the prototype tire when compared on a dimensionless basis. The structural modeling concept discussed in this report is believed to be exact for mechanical properties of aircraft tires under static, rolling, and transient conditions. Author

N73-21007# Politecnico di Milano (Italy). Ist. di Ingegneria Aerospaziale.
COMPARISONS BETWEEN ANALOGICAL AND NUMERICAL METHODS FOR STUDYING THE RESPONSE OF AN AIRCRAFT TO GUSTS [CONFRONTI FRA METODI ANALOGICI E NUMERICI PER LO STUDIO DELLA RISPOSTA DI UN VELIVOLO ALLA RAFFICA]
Luigi Puccinelli 1970 16 p refs In ITALIAN
(Publ-97) Avail: NTIS HC $3.00

Two mathematical models for representing nonstationary aerodynamic characteristics of a wing subjected to sharp variations in the angle of attack are used to study the response of an airfoil to ascending vertical gusts. Considering the airfoil to be a rigid body with two degrees of freedom, the flow over the wing in the horizontal plane of the tail and the drag encountered by the tail are calculated. The results obtained using analog and numerical methods are compared. Transl. by F.O.S.

N73-21008# Advisory Group for Aerospace Research and Development, Paris (France).
ADVANCED ROTORCRAFT, VOLUME 1
Feb. 1973 237 p refs Presented at the 39th meeting of the Flight Mech. Panel of AGARD, Hampton, Va., 20-23 Sep. 1971
(AGARD-CP-121) Avail: NTIS HC $14.00

The proceedings of a conference on rotary wing aircraft developments are presented. The objectives of the symposium are given as: (1) review of experiences gained from existing helicopter operations, (2) review of lessons obtained from flight tests of experimental helicopters, (3) discussion of the future of advanced rotorcraft, and (4) ground test facilities for research and development of new rotorcraft. For individual titles, see N73-21009 through N73-21030.

N73-21009 Service Technique Aeronautique, Paris (France).
TACTICAL FLIGHT OF HELICOPTER AND REPERCUSSIONS ON THE CONCEPTION [LE VOL TACTIQUE DE L'HELICOPTERE ET LES REPERCUSSIONS SUR SA CONCEPTION]
M. Berthoux *In* AGARD Advanced Rotorcraft, Vol. 1 Feb. 1973 5 p In FRENCH (For availability see N73-21008 12-02)

Certain reflections on the aspects of the problem of tactical helicopter flight are made in light of experience acquired in the domain of aeromobility. After having examined the tactical environment, research was done on the effects of such environments on helicopter performance. Transl. by E.H.W.

N73-21010 Royal Aircraft Establishment, Bedford (England).
THE OPERATION OF HELICOPTERS FROM SMALL SHIPS
J. B. B. Johnston *In* AGARD Advanced Rotorcraft, Vol. 1 Feb. 1973 15 p (For availability see N73-21008 12-02)

Procedures for operating helicopters from the decks of small ships are discussed. The subjects presented are: (1) an overall view of the operation, (2) types of helicopters in use, (3) types of ships used, (4) problem of deck size and superstructure, (5) nature and effect of air flow around the ship, and (6) problem of ship motion. Preliminary flight tests to investigate the identified problems are reported. Author

N73-21011 Societe Nationale Industrielle Aerospatiale, Paris (France).
TEN YEARS EXPERIENCE WITH THE HELICOPTER FROM OPERATION IN FRENCH ARMY [DIX ANS D'EXPERIENCE AVEC LES HELICOPTERES EN OPERATION DANS LES ARMEES FRANCAISES]
A. Renaud *In* AGARD Advanced Rotorcraft, Vol. 1 Feb. 1972 3 p In FRENCH (For availability see N73-21008 12-02)

Helicopter performance as determined by a ten year study in various military environments is reported. Data cover operational systems, special equipment, and various environmental situitations including tactical operations. Helicopter support activities are also discussed. Transl. by E.H.W.

N73-21012 Service Technique Aeronautique, Paris (France).
RELIABILITY AND SAFETY OF OPERATING MECHANICAL HELICOPTER PIECES [FIABILITE ET SECURITE EN OPERATION DES PIECES MECANIQUES POUR HELICOPTERES]
S. Berner *In* AGARD Advanced Rotorcraft, Vol. 1 Feb. 1973 9 p In FRENCH (For availability see N73-21008 12-02)

After determining the service life of the mechanical parts of a helicopter, fail safe system characteristics, qualifications of transmission box mechanisms, their initial contribution and potential utilization were determined. Fabrication materials and procedures from both Britain and the U.S. are compared. Transl. by E.H.W.

N73-21013 Army Aviation Systems Test Activity, Edwards, AFB, Calif.
GREATER SAFETY, MAINTAINABILITY, AND RELIABILITY THROUGH IMPROVED HELICOPTER FLIGHT TESTING
Gerald E. Swecker *In* AGARD Advanced Rotorcraft, Vol. 1 Feb. 1973 15 p refs (For availability see N73-21008 12-02)

Data obtained from helicopter flight test programs are presented. Greater safety, maintainability, and reliability are being assured through constantly improved flight testing techniques and the use of state-of-the-art instrumentation, data acquisition, and data reduction equipment. More stringent helicopter performance criteria are placing greater demands on the test agencies to devise new methods and procedures for collecting and analyzing data. Included are such programs as: (1) the AH-1G (Cobra) helicopter and a simplified approach to finding height loss during dive recovery from throttle chops; (2) recommendation of limiting AH-1G tail rotor control; (3) OH-6A g loads experienced at high frequencies during weapons firing; (4) recommended pilot cues to define a safe AH-1G envelope following engine failure; (5) investigation of large sideslip and pitch excursions following throttle chops in the TH-55 helicopter; (6) identification of requirements for AH-1G instrument-flight-rule (IFR) evaluation; (7) results from OH-58 and AH-1G helicopter height-velocity (H-V) (autorotational) testing with discussion of application to operational use; and (9) AH-1G maneuvering limits from return-to-target profiles. Tests conducted with the AH-1G helicopter determined return-to-target time, height lost during pullout from a dive, and other maneuvering characteristics. The

concept of energy maneuverability has been established, and significant data have been added to the literature. Author

N73-21014 Naval Air Test Center, Patuxent River, Md. Rotary Wing Branch.
A NEW LOOK AT HELICOPTER LEVEL FLIGHT PERFORMANCE
Allen B. Hill *In* AGARD Advanced Rotorcraft, Vol. 1 Feb. 1973 9 p (For availability see N73-21008 12-02)

Helicopter level flight performance data are presented as power coefficient (c sub p versus tip speed or advance ratio for a range of thrust coefficients (c sub t)). This data presentation was developed from momentum and blade element theory. The power coefficient is a nondimensional expression for the main rotor shaft horsepower required. The main rotor shaft horsepower required consists of profile, parasite and induced power. The advance or tip speed ratio is a nondimensional ratio of flight and main rotor rotational speed. The thrust coefficient is a nondimensional expression for thrust required. It should probably be called the weight coefficient, since vertical drag is normally ignored, and thrust is replaced by gross weight. A representative classic helicopter level flight performance curve is presented. Author

N73-21015 Royal Aircraft Establishment, Bedford (England).
SOME FLIGHT EXPERIMENTS ON THE XH-51 N HELICOPTER
P. Brotherhood and C. A. James *In* AGARD Advanced Rotorcraft, Vol. 1 Feb. 1973 12 p refs (For availability see N73-21008 12-02)

Flight tests of the XH-51N helicopter are reported. The tests were primarily concerned with helicopter stability and control. Several combinations of gyroscopes and control springs were evaluated. The principal effects of the changes in configuration were variations in control sensitivity and rotor damping. A variation in static stability due to a differently shaped gyro arm was reported. Author

N73-21016 Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany).
INFLUENCE OF ELASTIC COUPLING EFFECTS ON THE HANDLING QUALITIES OF A HINGELESS ROTOR HELICOPTER
G. Reichert and H. Huber *In* Agard Advanced Rotorcraft, Vol. 1 Feb. 1973 15 p refs (For availability see N73-21008 12-02)

Stability and control of a helicopter with a hingeless rotor system is mainly influenced by the elastic flapping motion of the rotor blades. On a rotor with torsionally flexible blades or elasticity in the control system there can be additional aeroelastic effects, which act as control inputs on the blades. After a short description of the rotor system and the analytical model, the reasons and the influences of elastic coupling effects on the stability and control behavior of a hingeless rotor helicopter are discussed. There are effects which result from the aerodynamic characteristics and from the chordwise mass-distribution on the blade. Additional coupling effects result from flapping and inplane deflections out of the pitching control axis similar to a pitch-flap-lag-coupling. Theoretical results are compared with flight test data. Author

N73-21017 Westland Helicopters, Ltd., Yeovil (England).
GROUND AND FLIGHT TEST EXPERIENCE WITH THE WESTLAND SCOUT HINGELESS ROTOR HELICOPTER
D. E. H. Balmford *In* AGARD Advanced Rotorcraft, Vol. 1 Feb. 1973 12 p (For availability see N73-21008 12-02)

The flight test experience gained during the basic clearance of a Westland Scout helicopter fitted with a reduced scale version of the hingeless rotor system is discussed. The basic clearance was aimed at producing an aircraft with sufficient capability to embark upon a series of research tasks and as such was devoted to investigating the airworthiness and handling of the aircraft broadly within the limit of the flight envelope of the standard production Scout fitted with an articulated rotor. Provided that these limits could be approached reasonably closely it was considered that the aircraft would be adequate for its research tasks. A statement of the present status of flight testing of the Lynx helicopter is included. Author

N73-21018 Societe Nationale Industrielle Aerospatiale, Paris (France).
SOME THOUGHTS ON THE SA 341 GAZELLE SPEED RECORD
J. Soulez-Lariviere *In* AGARD Advanced Rotorcraft, Vol. 1 Feb. 1973 4 p (For availability see N73-21008 12-02)

The speed record establishment for helicopters by the SA 341 helicopter is discussed. The nature of the course flown and the requirements for successful completion are described. The preparation of the helicopter for the record try is reported. Lessons to be drawn from this experience for future record tries are analyzed. Author

N73-21019 Army Air Mobility Research and Development Lab., Moffett Field, Calif.
PROGRESS IN ROTOR-BLADE AERODYNAMICS
P. F. Yaggy and I. C. Statler *In* AGARD Advanced Rotorcraft, Vol. 1 Feb. 1973 15 p refs (For availability see N73-21008 12-02)

The primary factors inhibiting the performance of rotary wing aircraft are identified. The inhibiting factors are examined and discussed with respect to developments in the aerodynamics of the rotor, the mathematical modeling of its wake, and the prediction of dynamic airloads and their effects on flying qualities. Recent developments in rotor flow studies, rotor blade pressure distributions, rotor blade boundary layer analyses, airfoil behavior in rotors, and rotor aerodynamics are presented. Author

N73-21020 Army Air Mobility Research and Development Lab., Fort Eustis, Va. Structures Div.
SURVEY OF ROTARY WING LOADS AND STABILITY ANALYSIS PROBLEMS
H. I. MacDonald *In* AGARD Advanced Rotorcraft, Vol. 1 Feb. 1973 6 p (For availability see N73-21008 12-02)

A survey of some to the problems encountered in the prediction of structural design loads and aeroelastic stability margins during the development of rotary wing aircraft is presented. The importance of accurate prediction of structural design loads for improved reliability, performance, and stability of aircraft is stressed. Variations in analysis methods employed by various manufacturers are discussed. The complexity involved in the prediction of rotary wing loads and aeroelastic stability, the effects on cost effectiveness, and areas where complex analysis is advantageous are reported. Author

N73-21021 United Aircraft Corp., Stratford, Conn.
IMPACT OF NEW STRUCTURAL CONCEPTS ON SYSTEM CAPABILITIES
Edward S. Carter *In* AGARD Advanced Rotorcraft, Vol. 1 Feb. 1973 11 p refs (For availability see N73-21008 12-02)

The impact of structural concepts on rotary wing system capabilities is examined. Current vertical takeoff aircraft system capabilities in terms of payload and gross weight ratio are reported. Examples of advances in vertical takeoff aircraft design are submitted. Specific developments in rotor blade construction, variable geometry concepts, drive systems, transmissions, and airframes are presented. Author

N73-21022 Boeing Co., Philadelphia, Pa. Vertol Div.
EVALUATION, DEVELOPMENT, AND ADVANTAGES OF THE HELICOPTER TANDEM DUAL CARGO HOOK SYSTEM
Gregory J. Wilson and Newton N. Rothman *In* AGARD Advanced Rotorcraft, Vol. 1 Feb. 1973 8 p refs (For availability see N73-21008 12-02)

Helicopter transport of external cargo for military applications, efficient use of available rotary-wing equipment, and enhancement of aircraft safety is examined. Improvements in this technique could provide the transport of external cargo at the maximum speed of the helicopter, routine operation under instrument flight rules (IFR), precise placement of the load, and could eliminate the problems in hover such as the dust cloud and static electricity. Feasibility studies have shown the potential of the tandem dual hook concept as a viable base on which to build an improved cargo-handling system. Production incorporation of a dual cargo hook system is planned for the heavylift helicopter (HLH). The system incorporates other features such as variable longitudinal hook positioning, differential winching, load motion feedback, and

augmentation of the cargo system operator's vision under conditions of poor light and thick dust. The requirements for an improved helicopter external cargo-handling system, the programs which have established the feasibility of a tandem dual cargo hook system, and the system slated for the heavy-lift helicopter are reported. Author

N73-21023 Westland Helicopters, Ltd., Yeovil (England).
MATERIALS FOR ADVANCED ROTORCRAFT
J. P. Jones *In* AGARD Advanced Rotorcraft, Vol. 1 Feb. 1973 6 p refs (For availability see N73-21008 12-02)

The development and application of composite materials for constructing airframes of vertical takeoff aircraft are discussed. The properties of carbon reinforced plastics are described and specific areas of application for airframes and rotors are identified. The design features which produce better handling qualities of rotary wing aircraft and which are possible by the use of improved composite materials are examined. Author

N73-21024 Hawker Siddeley Aviation, Ltd., Woodford (England).
STOPPED ROTOR AIRCRAFT USING CIRCULATION CONTROLLED ROTORS
John Taylor *In* AGARD Advanced Rotorcraft, Vol. 1 Feb. 1973 15 p refs (For availability see N73-21008 12-02)

The fundamental problems of the stopped rotor aircraft are examined. The aerodynamic characteristics of the circulation controlled rotor are discussed and the results of test data presented. Finally, the evolution of a typical stopped rotor aircraft design using circulation controlled rotors is illustrated. Author

N73-21025 Giravions Dorand Co., Paris (France).
FIELDS OF APPLICATION OF JET FLAPPED ROTORS
M. Kretz *In* AGARD Advanced Rotorcraft, Vol. 1 Feb. 1973 12 p refs (For availability see N73-21008 12-02)

Analysis of the field of application of the jet-flap rotor shows the cost-effectiveness of this technique when applied to heavy helicopter and stoppable rotor designs. Comparison with equivalent mechanically driven heavy-lift rotorcraft shows empty-weight gains of 30 to 40 percent. Initial cost gains for these vehicles is even higher, approaching 50 percent. The feasibility of an aircraft having a 0.85 Mach number capability and possessing a stoppable and stowable nonfolding two-bladed rotor has been established. The weight analysis also demonstrates the attraction of the jet-flap concept, which combines the features of both low weight and low cost, with a long duration hovering capability. The jet-flap rotor thus makes it possible for the same aircraft to have the high airspeed characteristics of a modern airplane coupled with the lowspeed advantages of a helicopter. Author

N73-21026 Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
RESEARCH AND DEVELOPMENT ON ROTORS WITH TIP REACTION DRIVE IN GERMANY
Christoph Fischer *In* AGARD Advanced Rotorcraft, Vol. 1 Feb. 1973 12 p refs (For availability see N73-21008 12-02)

Activities on cold, hot and mixed cycle tip jet propulsion for rotors are reported. Research and programs on cold and large mixed cycle systems are described. For both projects some results of component testing flight tests are discussed. Aspects of the flight mechanics as decoupling of movements in hovering and advantages of wide rpm-range are shown. Concluding remarks on the operational applicability and new missions favoring torque-free rotor drive systems are added. Author

N73-21027 Boeing Co., Philadelphia, Pa. Vertol Div.
SURVEY OF TILT ROTOR TECHNOLOGY DEVELOPMENT
K. B. Gillmore *In* AGARD Advanced Rotorcraft, Vol. 1 Feb. 1973 11 p refs (For availability see N73-21008 12-02)

A review is made of the development of tilt rotor technology since the XV-3 program in the late 1950's. A brief comparison of the capabilities of the tilt rotor with other rotary wing configurations for a transport mission is shown. Tilt rotor performance and dynamic model tests are described. Analytical methodology development is reviewed and predictions are shown to compare well with model test data in the areas of performance, aeroelastic stability and flying qualities. It is concluded that the technology is now in hand to develop a prototype vehicle. Author

N73-21028 Societe Nationale Industrielle Aerospatiale, Marignane (France.)
FENESTRON: NEW SOLUTION OF TAIL ROTOR [LE FENESTRON, SOLUTION NOUVELLE DE ROTOR DE QUEUE]
J. Gallot *In* AGARD Advanced Rotorcraft, Vol. 1 Feb. 1973 7 p In FRENCH (For availability see N73-21008 12-02)

A method for determining flight performance and flight qualities of a Fenestron type tail rotor is presented. Data cover vulnerability, effects of vibration on stationary flight performance, flight control, and maintenance. Transl. by E.H.W.

N73-21029 United Aircraft Corp., Stratford, Conn.
DEVELOPMENT OF THE ABC ROTOR
Robert K. Burgess *In* AGARD Advanced Rotorcraft, Vol. 1 Feb. 1973 17 p refs (For availability see N73-21008 12-02)

The development of the advancing blade concept (ABC) rotor is traced from conception through small scale model wind tunnel testing, full scale analysis, design, fabrication and ultimate wind tunnel testing of a 40 ft diameter rotor. The principal design tradeoffs resulting from the early analyses and testing are discussed along with their expected impact on the full scale rotor characteristics. Materials and manufacturing methods employed are covered including the more important difficulties that were surmounted during the nearly five years of development. Finally, the major test programs are outlined including blade balancing, turbine test bed operation and full scale wind tunnel testing facility up to speeds of 180 knots and advance ratios of .91. Significant results of these tests are presented, and applications to aircraft systems discussed. Author

N73-21030 Royal Aircraft Establishment, Bedford (England).
RAE EXPERIENCE IN THE USE OF A PILOTED GROUND-BASED SIMULATOR FOR HELICOPTER HANDLING STUDIES c11
T. Wilcock *In* AGARD Advanced Rotorcraft, Vol. 1 Feb. 1973 12 p refs (For availability see N73-21008 12-02)

Two studies using a ground-based piloted flight simulator for the assessment of helicopter handling qualities are described. The first simulation, of a Westland Wessex, was performed to establish the simulation techniques required for effective representation of handling behaviour. The second study was of the Westland Lynx, and was conducted prior to the first flight of that helicopter in order to provide assistance in the early development program. Results of the two simulations are discussed, and the experience gained from these tests is used to suggest some requirements for valid simulation. Author

N73-21031# Advisory Group for Aerospace Research and Development, Paris (France).
AERODYNAMICS OF ROTARY WINGS
Feb. 1973 449 p refs In ENGLISH; partly in FRENCH Presented at Fluid Dyn. Panel Specialists Meeting, Marseilles, 13-15 Sep. 1972
(AGARD-CP-111) Avail: NTIS HC $24.50

The proceedings of a conference on the fluid dynamics of rotary wings and methods for calculation and analysis of the aerodynamics and dynamics of rotary wing systems are presented. The subjects discussed include the following: (1) calculation of rotor wake characteristics and inflow distribution, (2) factors affecting performance at hover and high advance ratio, (3) description of analytical methods for calculating rotor unsteady aerodynamics, (4) trends in rotor blade airfoil design, and (5) measurement of aerodynamic noise generated by rotary wings. For individual titles, see N73-21032 through N73-21056.

N73-21032 United Aircraft Corp., East Hartford, Conn.
ROTOR WAKES: KEY TO PERFORMANCE PREDICTION
Anton J. Landgrebe and Marvin C. Cheney, Jr. *In* AGARD Aerodyn. of Rotary Wings Feb. 1973 19 p refs (For availability see N73-21031 12-02)

The history of helicopter performance prediction methods and the influence of rotor wakes are traced from the simple momentum techniques used in the early years of propellers and rotors to the current state-of-the-art computer programs simulating the rotor's complex vortex structure. Analytical and experimental techniques are described which define the geometry of the vortex field of a hovering rotor and its effect on rotor

performance. It was concluded that the most important factor which influences the prediction of hover performance was the interference caused by the tip vortex during its first revolution. Integrated performance in forward flight was generally not sensitive to variable inflow; however, when combined with unsteady airfoil data, variable inflow produced significant effects on blade torsional responses. Author

N73-21033 Army Air Mobility Research and Development Lab., Moffett Field, Calif.

AN ACTUATOR DISC THEORY FOR ROTOR WAKE INDUCED VELOCITIES

Robert A. Ormiston *In* AGARD Aerodyn. of Rotary Wings Feb. 1973 19 p refs (For availability see N73-21031 12-02)

A general actuator disc theory is presented for predicting the time-averaged downwash distribution, and steady state force and moment response characteristics of helicopter rotors in forward flight. Particular attention is given to a proper definition of the rotor potential flow problem. The formulation of the theory is conceptually based on classical fixed-wing lifting-line theory to enhance its versatility and provide insight about the complex physical features of the rotor downwash distribution. The method of solution expresses the rotor downwash in a fourier series where the coefficients are given as a summation of influence functions. It is shown that the rotor wake vorticity can be assumed to lie in a flat planar wake for a wide range of flight conditions, thus simplifying the Biot-Savart integration for the downwash. The vorticity elements in the flat planar wake are decomposed into simple circular and linear elements to further simplify the integrations. Author

N73-21034 Westland Aircraft, Ltd., Yeovil (England).

THE STRUCTURE OF THE ROTOR BLADE TIP VORTEX

C. V. Cook *In* AGARD Aerodyn. of Rotary Wings Feb. 1973 14 p refs (For availability see N73-21031 12-02)

The results of a set of experiments to measure the velocity distribution through a helicopter rotor blade tip vortex are presented. The experiments were conducted on a single full scale rotor blade operating at a representative tip speed on a whirl tower. The rotor was mounted in the inverted position (thrusting downward) to reduce the ground effects and produce a steady flow through the rotor. The vortex velocity distributions were measured for a range of vortex ages and a number of blade loadings, the highest of which was above that normally associated with a hovering rotor. A vortex "age" range in terms of blade rotation of approximately 70 to 380 degrees of azimuth was covered. Flow visualisation using smoke was employed to determine the trajectory of the vortex and a hot wire aneomometer to measure the induced velocities associated with the tip vortex. Author

N73-21035 Georgia Inst. of Tech., Atlanta. School of Aerospace Engineering.

A VORTEX ANALYSIS OF A SINGLE BLADED HOVERING ROTOR AND A COMPARISON WITH EXPERIMENTAL DATA

Robin B. Gray and George W. Brown *In* AGARD Aerodyn. of Rotary Wings Feb. 1973 14 p refs (For availability see N73-21031 12-02)

A theoretical method is developed for determining the geometry and strength distribution of the vortex wake generated by a single-bladed hovering helicopter rotor. The analysis begins with a simple model of the ultimate wake geometry and then proceeds to establish the corresponding nondimensional tip-vortex strength. This simple vortex-wake model is adjusted by procedures that are based on the Biot-Savart law to obtain a first approximation for the tip-vortex geometry. Next, an estimate of the blade collective pitch angle is found from blade-element considerations. Then, a first approximation for the geometries and strengths of the vortex-sheet filaments that are shed from the blade trailing edge is determined by marching inboard from the blade tip. Thus, a simultaneous solution for the filament strengths is not required. Futher adjustments to the wake geometry, the strenghts of the inboard filaments, and the collective pitch are made until succeeding changes become acceptably small. Author

N73-21036 Societe Nationale Industrielle Aerospatiale, Marseille (France).

ROTOR STATIONARY FLIGHT AND LARGE ADVANCEMENT PARAMETERS [ROTOR EN VOL STATIONNAIRE ET A GRAND PARAMETRE D'AVANCEMENT]

J. Soulez-Lariviere *In* AGARD Aerodyn. of Rotary Wings Feb. 1973 29 p In FRENCH (For availability see N73-21031 12-02)

A technique which permits vertical flight by a helicopter rotor is disclosed. The historical development of a conduit is explored, after which the diverse shock limitations on stationary and translation flight are examined. A historical account is also given of the methods used to improve and calculate the performance of helicopter rotors. Transl. by E.H.W.

N73-21037 Societe Nationale Industrielle Aerospatiale, Marseille (France).

ROTOR REQUIREMENTS BEYOND THE USUAL FLIGHT DOMAIN OF ONERA LARGE WIND TUNNEL AT MONDANE [COMPORTEMENT D'UN ROTOR AU-DELA DU DOMAINE DE VOL USUEL A LA GRANDE SOUFFLERIE DE MODANE]

Michel Lecarme *In* AGARD Aerodyn. of Rotary Wings Feb. 1973 14 p In FRENCH; ENGLISH summary (For availability see N73-21031 12-02)

Several series of tests have been performed on a 4.150 meter diameter experimental rotor in the large wind tunnel. The blades stiffness and available power of test equipment in the wind tunnel made a number of measurements and visualizations possible in some severe configurations and at high tip speeds. During the exploration of the test envelopes for various sets of blades, a tip speed ratio of .87 was reached; the retreating blade stall was studied at several values of preset parameters, such as: wind speed, rotor tip speed, rotor shaft tilt, and collective pitch. The present rotor head is not provided with cyclic pitch control. Operating limits for a conventional rotor were determined in terms of tip speed ratio. Development of retreating blade stall is affected by the reverse flow area and vortex interactions and this stall produces disturbances which increase as the tip speed ratio decreases. Author

N73-21038 United Aircraft Corp., Stratford, Conn. Sikorsky Aircraft Div.

AERODYNAMIC FACTORS INFLUENCING OVERALL HOVER PERFORMANCE

Evan A. Fradenburgh *In* AGARD Aerodyn. of Rotary Wings Feb. 1973 11 p refs (For availability see N73-21031 12-02)

Improvements in basic rotor design practice are described and results of several series of model rotor tests are discussed. Moderate values of blade root cutout are shown to have an unanticipated effect on hovering efficiency. A large root cutout decreases figure of merit of the rotor, but also reduces vertical drag of a typical airframe below the rotor, cutting the aerodynamic penalty to about half of what tests of the rotor alone would indicate. Tests of a tilt-rotor model show that, unlike the conventional single rotor helicopter configuration, the rotors do not benefit from a partial ground effect caused by the airframe in the rotor downwash field. The relationship of blade twist and ground effect is discussed, and the influence of ground proximity on vertical drag is presented. It is shown that net airframe vertical drag can be zero or negative when the aircraft is close to the ground. Additional systematic experimentation is clearly needed, as is the development of theory to cover the various relationships involved in overall hover efficiency. Author

N73-21039 Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).

THE ROTOR IN AXIAL FLOW

Herbert Zimmer *In* AGARD Aerodyn. of Rotary Wings Feb. 1973 16 p refs (For availability see N73-21031 12-02)

The aerodynamic characteristics of rotary wings under axial flow conditions are discussed. An outline of the calculation methods is given. A vortex method is used for one type of calculation. A momentum-blade element method is applied in another case because of the widely separated flow. Emphasis is placed on quick solution of the equations because of the need for frequent use in a design cycle and during performance calculations. Author

N73-21040 Canadair, Ltd., Montreal (Quebec).

THE DEVELOPMENT OF AN EFFICIENT HOVERING PROPELLER/ROTOR PERFORMANCE PREDICTION

METHOD
D. C. Gilmore and I. S. Gartshore (British Columbia Univ.) *In* AGARD Aerodyn. of Rotary Wings Feb. 1973 24 p refs (For availability see N73-21031 12-02)

The development of a method for predicting the performance of heavily loaded propellers and rotors in steady hovering flight is described. The method has two particularly useful characteristics: (1) certain simplifying assumptions which allow consistency in the analytical model to be achieved with only a few small scale iterations and (2) a need for only a part of the wake to be specified. The analytical model, built up from three basic elements, includes a single vortex filament shed from the tip of each blade, a vortex sheet shed inboard of the point of maximum bound circulation on each blade, and an outboard sheet rolling up to form the tip vortex at an arbitrary angle. Roll-up angle affects the circumferential variation of induced velocity components but not their mean values. Application of the method to three propellers shows that accuracy of results is dependent upon realism of the assumed wake geometry. Author

N73-21041* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A SUMMARY OF CURRENT RESEARCH IN ROTOR UNSTEADY AERODYNAMICS WITH EMPHASIS ON WORK AT LANGLEY RESEARCH CENTER c01
John F. Ward and Warren H. Young, Jr. *In* AGARD Aerodyn. of Rotary Wings Feb. 1973 20 p refs Prepared in cooperation with Army Air Mobility R and D Lab., Fort Eustis, Va. (For availability see N73-21031 12-02)

The basic unsteady aerodynamic environment of the rotary wing is summarized. Some of the observed trends in the state of the art are discussed. Some of the research needs that will require attention are reported. A review of a number of research investigations as a part of a joint NASA/Army rotorcraft project is presented. The research is directed toward achieving a better understanding of rotor unsteady airfoils. The investigations include: (1) rotor maneuver loads; (2) level flight and maneuver wake prediction; (3) tip-vortex flow; (4) blade-vortex interactions; (5) dynamic stall; (6) transient Mach number air loads; and (7) development of variable geometry rotors. Author

N73-21042 Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
AERODYNAMIC FORCES COMPUTATION AND MEASUREMENT ON AN OSCILLATING AEROFOIL PROFILE WITH AND WITHOUT STALL c01
J. J. Philippe and M. Sagner *In* AGARD Aerodyn. of Rotary Wings Feb. 1973 13 p refs In FRENCH; ENGLISH summary (For availability see N73-21031 12-02)

Research projects on computing and measuring aerodynamic forces on oscillating airfoil profiles are discussed. The problems created by unsteady aerodynamic stalling of rotary wings are emphasized. The experimental findings are analyzed as a function of mean angle of attack, oscillations amplitude, reduced frequency, and Mach number. Computed results are compared with experimental data. Author

N73-21043 Aix-Marseilles Univ. (France). Inst. de Mecanique des Fluides.
AERODYNAMIC EFFORTS ON A LARGE WING PROFILE WITH QUICK HARMONIC MOVEMENT PARALLEL TO SIEVE FLOW [EFFORTS AERODYNAMIQUES SUR UN PROFIL D'AILE ANIME D'UN MOVEMENT HARMONIQUE PARALELE A L'ECOULEMENT MOUVEMENT DE TAMIS]
J. Valensi and J. Rebont (CNRS) *In* AGARD Aerodyn. of Rotary Wings Feb. 1973 14 p refs In FRENCH (For availability see N73-21031 12-02)

The effects of drag, lift, and pitching moments on a rectangular wing profile system were measured. Measurements were taken at different incidences and different values of advancement parameters. Transl. by E.H.W.

N73-21044* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A COMPRESSIBLE UNSTEADY THEORY FOR HELICOPTER ROTORS
Charles E. Hammond and G. Alvin Pierce (Ga. Inst. of Tech.) *In* AGARD Aerodyn. of Rotary Wings Feb. 1973 15 p refs Prepared in cooperation with Army Air Mobility Res. and Develop. Lab., Ft. Eustis, Va. (For availability see N73-21031 12-02) (Contract DAHC04-68-C-0004)

An aerodynamic theory is presented which allows the determination of the unsteady aerodynamic loading on a reference section of a helicopter rotor blade in axial or hovering flight under compressible flow conditions. The aerodynamics of the two-dimensional flow model are formulated using a kernel function approach. By introducing the acceleration potential the governing integral equation for the flow and its attendant downwash boundary condition are developed and solved numerically using a pressure mode assumption and a collocation technique. The compressible aerodynamic theory thus developed is compared analytically with two other existing theories, one incompressible and one compressible, and is shown to agree with these theories provided that the appropriate limit is taken so that the flow models agree. The ratio of blade oscillatory frequency to rotor rotational frequency is shown to be the correlation parameter between the two flow models. Author

N73-21045 Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany).
SOME ASPECTS OF THE DESIGN OF ROTOR-AIRFOIL SHAPES
G. Reichert and S. N. Wagner *In* AGARD Aerodyn. of Rotary Wings Feb. 1973 22 p refs (For availability see N73-21031 12-02)

Analytical studies have shown that performance, stability and control of helicopters can be improved if some characteristics of rotor airfoils could be changed. Starting from given airfoil shapes the characteristics of these airfoils are idealized by changing lift curve slope, maximum lift boundary, and beginning of drag divergence. The influences of these changes on the power required, the stability and control of hingeless rotor helicopters are studied. Furthermore, the desirable characteristics of an airfoil or several airfoils of a rotor are defined using these idealized characteristics and analysing common missions of a given helicopter. Similar studies of a larger field of missions and helicopters could lead to new areas of research and development to design advanced profile shapes of helicopters of the future. Several analytical tools for the design of airfoils are discussed. Author

N73-21046 Army Air Mobility Research and Development Lab., Moffett Field, Calif.
RECENT DEVELOPMENTS IN ROTOR BLADE STALL
W. J. McCroskey *In* AGARD Aerodyn. of Rotary Wings Feb. 1973 13 p refs (For availability see N73-21031 12-02)

Developments in techniques for analyzing boundary layers of rotary wings are discussed. The basic effects of rotation and crossflow due to forward flight have been identified and found to be insignificant for most cases of practical interest in helicopter aerodynamics. Within the framework of classical thin boundary theory, unsteady viscous effects are also small. Unsteady viscous-inviscid interaction appears to play an important role in retreating blade stall. The characteristics of retreating blade stall are described based on vortex-like disturbance from the leading edge of the rotor blade. Author

N73-21047 Royal Aircraft Establishment, Farnborough (England).
THE DERIVATION AND VERIFICATION OF A NEW ROTOR PROFILE ON THE BASIS OF FLOW PHENOMENA: AEROFOIL RESEARCH AND FLIGHT TESTS
H. H. Pearcey, P. G. Wilby, M. J. Riley, and P. Brotherhood *In* AGARD Aerodyn. of Rotary Wings Feb. 1973 18 p refs (For availability see N73-21031 12-02)

An account is given of some of the considerations that governed the derivation of new profiles to be incorporated in the design of the rotor blades for the Lynx helicopter at its inception. The changes relative to the NACA 0012 profile were conservative but were chosen to give consistent and significant all-round improvements to the shock-induced limits on the advancing blade, to the retreating-blade thrust limits and to the loading that could be sustained without shock-wave drag in hover. The conservatism applied especially to the stalling characteristics which play such a dominant part in limiting rotor performance but which are so difficult to predict for the rotor environment. The profiles were derived on the basis of steady flow aerofoil tests, but qualitatively similar improvements have been verified

in oscillatory aerofoil tests and in flight. A technique, used in the latter tests, is described for measuring pressure distributions along the blade chord and across the blade wake in the region of the rotor tip in flight. Author

N73-21048 Army Air Mobility Research and Development Lab., Moffett Field, Calif.
THE EFFECT OF PLANFORM SHAPE ON THE TRANSONIC FLOW PAST ROTOR TIPS
W. F. Ballhaus and F. X. Caradonna *In* AGARD Aerodyn. of Rotary Wings Feb. 1973 12 p refs (For availability see N73-21031 12-02)

A numerical relaxation algorithm capable of calculating the transonic inviscid flow about arbitrary planform rotors has been developed. The essential feature of this method is a transformation in which arbitrary planforms are converted to rectangles and all boundary condition problems are transferred to the equation of motion. Preliminary numerical calculations are presented for blades of various sweeps and profiles. It is seen that three-dimensional effects remove sweep effects and can cause shocks which are locally more severe than would occur in less swept or even unswept planforms. The method presents itself as a means of checking various rotor configurations before any tests are made. Author

N73-21049* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A SUMMARY OF WIND TUNNEL RESEARCH ON TILT-ROTORS FROM HOVER TO CRUISE FLIGHT
Ph. Poisson-Quinton and W. L. Cook *In* AGARD Aerodyn. of Rotary Wings Feb. 1973 16 p refs (For availability see N73-21031 12-02)

An experimental research program conducted on a series of tilt rotors designed for a range of blades twist is reported. The test facilities used in the program are identified. The objective of the program was to obtain precise results on the influence of blades twist and aeroelasticity on tilt rotor performance from hover to high speed cruise Mach number to 0.7. Five aluminum rigid rotors and one fiber glass composite rotor were tested. Author

N73-21050 Naval Ship Research and Development Center, Bethesda, Md.
RECENT DEVELOPMENTS IN CIRCULATION CONTROL ROTOR TECHNOLOGY
Robert Williams *In* AGARD Aerodyn. of Rotary Wings Feb. 1973 19 p refs (For availability see N73-21031 12-02)

Research on the historical concept of circulation control applied to rotor blades is presented. A high speed helicopter application is used to illustrate the potential of this rotor for a major breakthrough in the areas of rotor efficiency, parasite drag and weights leading to a large improvement in aircraft productivity. Details of the hover, transition and high speed cruise performance are presented. Some problems of autorotation, vibrations and blade dynamics are also discussed. Author

N73-21051 Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany).
SOME OBJECTIVES IN APPLYING HINGELESS ROTORS TO HELICOPTERS AND V/STOL AIRCRAFTS
H. B. Huber *In* AGARD Aerodyn. of Rotary Wings Feb. 1973 16 p refs (For availability see N73-21031 12-02)

Some of the aerodynamic, dynamic and aeroelastic problems in rotor design for helicopters and V/STOL-aircraft are discussed. After a short description of the main features of the hingeless rotor concept the most important research and design areas of the system are indicated. Attention is given to the flapping and inplane stiffness of the blade root section, the aerodynamic and dynamic blade design, the rotor hub geometry and the control system flexibility. The aeroelastic characteristics and some important parameter sensitivities are reported. The analytical and experimental studies include control and flight dynamic characteristics, structural loads, damping behaviour and aeroelastic stability. Analytical results are compared with test data. Based on these results some design criteria are provided and recommendations are made for a successful application of hingeless rotor systems on helicopters and tilting prop/rotor aircrafts. Author

N73-21052 SIAI Marchetti S.p.A., Varese (Italy).
AERODYNAMICS OF HELICOPTER COMPONENTS OTHER THAN ROTORS
Angelo Bosco *In* AGARD Aerodyn. of Rotary Wings Feb. 1973 16 p refs (For availability see N73-21031 12-02) (Contract DAJA37-72-C-1998)

The effects of parameters other than rotary wings on the performance of helicopters are discussed. Specific examples for the design of the SV-20A winged helicopter are presented. Wind tunnel tests to isolate aerodynamic interferences and to confirm aerodynamic analyses are described. The application of nonrotating component aerodynamics to optimization of the helicopter design is reported. Author

N73-21053* Loughborough Univ. of Technology (England).
FUNDAMENTAL CONSIDERATION OF NOISE RADIATION BY ROTARY WINGS
Martin V. Lowson *In* AGARD Aerodyn. of Rotary Wings Feb. 1973 18 p refs Sponsored by NASA and Natl. Gas Turbine Estab. (For availability see N73-21031 12-02)

An historical review of progress in understanding of rotor noise is presented. Initial work was principally on propellers, but has many obvious applications to noise from rotary wings. Current understanding of rotor noise radiation is then reviewed in some detail. The principal noise sources appear to be: (1) discrete frequency due to distorted inflow; (2) low frequency broadband due to turbulent inflow, and (3) high frequency broadband due to tip effects. On a helicopter rotor each of these sources seems to be intimately connected with the shed vortex wakes. Tip modifications offer one method for controlling the effects. The implications for the designer are discussed. Rotor subjective noise levels appear to obey a velocity to the eighth power law, independent of thrust. Experiments to rectify some of the present deficiencies in knowledge are suggested. Author

N73-21054 Bogazici Univ., Istanbul (Turkey).
WAKE CHARACTERISTICS OF A TWO DIMENSIONAL ASYMMETRIC AEROFOIL c01
Ibrahim Kavrak *In* AGARD Aerodyn. Rotary Wings Feb. 1973 7 p refs (For availability see N73-21031 12-02)

The process by which dipole noise is generated by the turbulent wake behind an airfoil is discussed. The characteristics of the wake are investigated and compared to the drag and lift coefficients as well as the noise radiated. It is concluded that both the drag coefficient and the generated noise are closely related to the turbulent shear in the separated flow area. The maximum velocity defect is shown to be an important parameter which affects both the performance and the noise intensity. Author

N73-21055 Societe Nationale Industrielle Aerospatiale, Marseille (France).
MEASURE OF HELICOPTER NOISE DURING FLIGHT [MESURES DE BRUIT D'HELICOPTERES EN VOL]
Fernand DAmbra, Jean-Pierre Dedieu, and Alain Julienne (ONERA, Chatillon, France) *In* AGARD Aerodyn. of Rotary Wings Feb. 1973 15 p refs In FRENCH; ENGLISH summary (For availability see N73-21031 12-02)

Noise measurements have been performed on several helicopters. These tests were aimed toward a complete survey of helicopters' internal and external noise levels in several flight conditions. Data analysis of flyover tests follows conventional aircraft's acoustical certification procedure. Test results are corrected to duplicate nominal flight path and standard atmosphere conditions in several noise units. A statistical analysis of maximum noise levels has been performed and results are presented with their confidence level. The use of the trajectography equipment grants in addition the exact timing of acoustical spectra from which directivity patterns of noise radiated from the complete aircraft in flight and from particular noise sources can be obtained. Author

N73-21056 Westland Helicopters, Ltd., Yeovil (England).
THE NOISE CHARACTERISTICS OF A LARGE CLEAN ROTOR
John W. Leverton *In* AGARD Aerodyn. of Rotary Wings Feb. 1973 14 p refs (For availability see N73-21031 12-02)

A 2-bladed 56-ft diameter rotor was run on a tower in an

inverted mode so that the problem of recirculation and the difficulties of measuring noise directivity characteristics could be overcome. This paper outlines the analysis procedure used and presents the detailed results obtained. From a practical point of view rotor noise can be considered to consist of rotational or discrete frequency noise, low frequency broadband noise and high frequency broadband noise. The spectrum characteristics and the directivity patterns of each of these sources have been examined as a function of the blade tip speed, the total rotor thrust and the measurement angle relative to the rotor disc plane. The trends associated with the overall noise, which is dependent on the relative magnitude of the individual sources, have also been studied. These results have been compared, where possible, with the trends given by theoretical and semi-empirical prediction methods. Time history traces are also included; these show that even under ideal conditions rotor noise is impulsive in nature. Author

N73-21057*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SOME EFFECTS OF GROOVED RUNWAY CONFIGURATIONS ON AIRCRAFT TIRE BRAKING TRACTION UNDER FLOODED RUNWAY CONDITIONS
Thomas A. Byrdsong Washington Apr. 1973 26 p refs
(NASA-TN-D-7215; L-8227) Avail: NTIS HC $3.00 CSCL 01C

An experimental investigation was conducted to study the effect of grooved runway configurations on aircraft tire braking traction on flooded runway surfaces. The investigation was performed, utilizing size 49 x 17, type VII, aircraft tires with an inflation pressure of 170 lb per square inch at ground speeds up to approximately 120 knots. The results of this investigation indicate that when the runway is flooded, grooved surfaces provide better braking traction than an ungrooved surface and, in general, the level of braking traction was found to improve as the tire bearing pressure was increased because of an increase in the groove area of either the surface or the tire tread. Rounding the groove edges tended to degrade the tire braking capability from that developed on the same groove configuration with sharp edges. Results also indicate that braking friction coefficients for the test tires and runway surfaces decreased as ground speed was increased because of the hydroplaning effects. Author

N73-21058*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EXPERIMENTAL INVESTIGATION OF THE CORNERING OF A C40 x 14-21 CANTILEVER AIRCRAFT TIRE
Robert C. Dreher and John A. Tanner Washington Apr. 1973 23 p refs
(NASA-TN-D-7203; L-8766) Avail: NTIS HC $3.00 CSCL 01C

An experimental investigation was conducted at the Langley aircraft landing loads and traction facility to define the cornering characteristics of a size C40 x14-21 aircraft tire of cantilever design. These characteristics, which include the cornering-force and drag-force friction coefficients and self-alining torque, were obtained for the tire operating on dry, damp, and flooded runway surfaces over a range of yaw angles from 0 deg to 20 deg and at ground speeds of 5 to 100 knots, both with and without braking. The results of this investigation show that the cornering-force and drag-force friction coefficients and self-alining torque were influenced by the yaw angle, ground speed, brake torque, surface wetness, and the locked-wheel condition. Author

N73-21059*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NOISE MEASUREMENTS FOR VARIOUS CONFIGURATIONS OF A MODEL OF A MIXER NOZZLE EXTERNALLY BLOWN FLAP SYSTEM
Jack H. Goodykoontz, Jack M. Wagner, and Noel B. Sargent Washington Apr. 1973 29 p refs
(NASA-TM-X-2776; E-7300) Avail: NTIS HC $3.00 CSCL 20A

Noise data were taken for variations to a large scale model of an externally blown flap lift augmentation system. The variations included two different mixer nozzles (7 and 8 lobes), two different wing models (2 and 3 flaps), and different lateral distances between the wing chord line and the nozzle centerline. When the seven lobe was used with the trailing flap in the 60 deg position, increasing the wing to nozzle distance had no effect on the sound level. When the eight lobe nozzle was used there was a decrease in sound level. With the 20 deg flap setting the noise level decreased when the distance was increased using either nozzle. Author

N73-21060# RAND Corp., Santa Monica, Calif.
LOW COST TACTICAL RPVs
R. H. Jacobson Sep. 1972 10 p
(P-4902) Avail: NTIS HC $3.00

The development of low cost remotely piloted vehicles is discussed. The emphasis is placed on development of an unconstrained innovative approach in establishing the logistic and maintenance characteristics which can significantly influence the overall design of remotely piloted vehicles and the required ground support equipment. Methods in which the costs of unmanned flying vehicles can be reduced are proposed. The application of automated production procedures and the use of composite materials are recommended. Author

N73-21061# National Transportation Safety Board, Washington, D.C.
AIRCRAFT ACCIDENT REPORT: AMERICAN AIRLINES, INCORPORATED, MCDONNELL-DOUGLAS DC-10-10, N103AA, NEAR WINDSOR, ONTARIO, CANADA, 12 JUNE 1972
28 Feb. 1973 44 p
(NTSB-AAR-73-2) Avail: NTIS HC $4.25

A DC-10-10 was damaged substantially when the aft bulk cargo compartment door separated from the aircraft in flight at approximately 11,750 feet mean sea level. The separation caused rapid decompression, which, in turn, caused failure of the cabin floor over the bulk cargo compartment. The separated door caused minor damage to the fuselage above the door and substantial damage to the leading edge and upper surface of the left horizontal stabilizer. There were 56 passengers and a crew of 11 aboard the aircraft. Two stewardesses and nine passengers received minor injuries. The probable cause of this accident was the improper engagement of the latching mechanism for the aft bulk cargo compartment door during the preparation of the airplane for flight. The design characteristics of the door latching mechanism permitted the door to be apparently closed when, in fact, the latches were not fully engaged, and the latch lockpins were not in place. Author

N73-21062# National Transportation Safety Board, Washington, D.C.
AIRCRAFT ACCIDENT REPORT: TRANS WORLD AIRLINES, INCORPORATED, BOEING 707-331C, N15712, FLIGHT 604, SAN FRANCISCO, CALIFORNIA, 13 SEPTEMBER 1972
14 Mar. 1973 12 p
(NTSB-AAR-73-4) Avail: NTIS HC $3.00

On September 13, 1972, a Boeing 707-331C, on a scheduled cargo flight from San Francisco, California, to John F. Kennedy International Airport, Jamaica, New York, crashed into San Francisco Bay following a rejected takeoff. There were no injuries to the three crewmembers, the only occupants on board. The aircraft was substantially damaged. The probable cause of this accident was the initiation of rejected takeoff procedures, beyond V sub 1 speed, with insufficient runway remaining in which to stop the aircraft. The crew action was prompted by the failure of the two right truck rear tires which produced a noticeable aircraft vibration and a reduction in aircraft acceleration. Author

N73-21063# Hydrospace-Challenger, Inc., Rockville, Md.
RESULTS OF NOISE SURVEYS OF SEVENTEEN GENERAL AVIATION TYPE AIRCRAFT Final Report
Damon C. Gray Dec. 1973 74 p
(Contract DOT-FA73WA-3179)
(FAA-EQ-73-1) Avail: NTIS HC $5.75

Noise levels, in terms of EPNL, PNL, dBA and dBD, are presented for both jet and propeller-driven general aviation type aircraft. The noise levels were derived from measurements taken by the FAA and NASA/LRC at the National Aviation Facilities Experimental Center. Levels derived from actual take-off and

constant altitude fly-bys are presented wherever possible.
Author

N73-21064# Federal Aviation Administration, Washington, D.C. Office of Environmental Quality.
AIRCRAFT SOUND DESCRIPTION SYSTEM: BACKGROUND AND APPLICATION Final Report
J. E. Cruz Mar. 1973 60 p refs
(FAA-EQ-73-3) Avail: NTIS HC $5.00

An objective approach to describing aircraft sound levels for areas in the vicinity of airports called Aircraft Sound Description System (ASDS), suitable for both manual and computer application, is presented. The basic premise of the concept is to state exposure to aircraft sound in terms of the amount of time that sound levels exceed a preselected threshold value. The rationale supporting the selection of this procedure, the selection of the threshold value, as well as some operating time constants, is covered together with two hypothetical applications. Author

N73-21065*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.
LF460 DETAIL DESIGN FINAL TECHNICAL REPORT ON AIRCRAFT SUPPORT ACTIVITY Contractor Report, Jun. 1971 - Mar. 1972
Apr. 1973 121 p refs
(Contract NAS2-6056)
(NASA-CR-121146) Avail: NTIS HC $8.25 CSCL 01C

Various studies and analyses that were performed in support of the V/STOL research transport design effort are discussed. The propulsion system specified for these studies was the LF460/YJ97-GE-100 turbotip lift fan. Strong emphasis was placed on achieving low fan noise while maintaining the high thrust/weight capability of the high pressure ratio lift fan system. The work was divided into cycle analysis and performance studies, installation and systems support, acoustic analysis and preliminary or conceptual design studies. Author

N73-21066*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
JET EXHAUST NOISE SUPPRESSOR Patent Application
Ronald G. Huff, inventor (to NASA) Filed 9 Mar. 1973 8 p refs
(NASA-Case-LEW-11286-1; US-Patent-Appl-SN-339806) Avail: NTIS HC $3.00 CSCL 01C

Noise suppression for a jet engine is provided by an annular divergent body attached to an exhaust nozzle. The smallest diameter of the divergent body is larger than the diameter of the exhaust nozzle exit to form an annular step which produces a shock wave in the exhaust as it passes the step. An annular shroud is disposed around the divergent body and causes outside air to pass through voids in the divergent body to mix with the jet exhaust gas. The divergent body includes a plurality of channels with separators between the channels. NASA

N73-21067*# Pennsylvania State Univ., University Park. Acoustics and Noise Control Lab.
DESIGN AND DEVELOPMENT OF THE SPINNING MODE SYNTHESIZER
John M. Seiner and Gerhard Reethof Washington NASA Apr. 1973 57 p refs
(Grant NGL-39-009-121)
(NASA-CR-2260) Avail: NTIS HC $3.00 CSCL 20A

Design and development of a flexible source of spinning modes which is capable of generating independent spinning waves of controlled complexity and spin speed without the introduction of broad band elements is reported. These features were accomplished through the use of eight commercial loudspeakers located in an equally spaced circular array with diameter of 11 inches and properly phased so that the system could generate a spinning wave. The constructed apparatus was tested in an anechoic environment and found capable of generating a plane, one and two lobed spinning wave of high quality with a sound pressure level of 120 dB and at frequencies ranging from 1500 to 2500 Hz at a distance of 4 ft in the far field. The wave speeds investigated varied from 8000 to 18000 rad/sec which represent supersonic peripheral speeds. Author

N73-21068*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A FLIGHT INVESTIGATION OF THE TRAILING VORTICES GENERATED BY A JUMBO JET TRANSPORT
Harry A. Verstynen, Jr. and R. Earl Dunham, Jr. Washington Apr. 1973 44 p refs
(NASA-TN-D-7172; L-8706) Avail: NTIS HC $3.00 CSCL 01C

A flight investigation has been conducted to study the velocity and persistence characteristics of the trailing vortices generated by a jumbo jet transport. The investigation showed that the tangential velocities were initially higher for vortices generated with the flaps up and that they persisted for longer distances behind the aircraft than those generated with the flaps down. The core radii with flaps down appeared to be generally larger than those with flaps up. The vertical locations of the vortices behind the generating aircraft varied from several hundred meters below the generating aircraft flight path at long ranges up to, and occasionally above, the flight path at short and moderate ranges. Author

N73-21069*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ELASTOHYDRODYNAMIC PRINCIPLES APPLIED TO THE DESIGN OF HELICOPTER COMPONENTS
Dennis P. Townsend 11 May 1973 11 p refs Presented at 29th Natl. Forum of the Am. Helicopter Soc., Washington, D. C., 10-11 May 1973
(NASA-TM-X-68215) Avail: NTIS HC $3.00 CSCL 01C

Elastohydrodyhamic principles affecting the lubrication of transmission components are presented and discussed. Surface temperature of the transmission bearings and gears affect elastohydrodynamic film thickness. Traction forces and sliding as well as the inlet temperature determine surface temperatures. High contact ratio gears cause increased sliding and may run at higher surface temperatures. Component life is a function of the ratio of elastohydrodynamic film thickness to composite surface roughness. Lubricant starvation reduces elastrohydrodynamic film thickness and increases surface temperatures. Methods are presented which allow for the application of elastohydrodynamic principles to transmission design in order to increase system life and reliability. Author

N73-21070*# Pratt and Whitney Aircraft, East Hartford, Conn.
HIGH LOADING, LOW SPEED FAN STUDY, 5 Final Report
M. J. Keenan and E. A. Burdsall Apr. 1973 143 p refs
(Contract NAS3-10483)
(NASA-CR-121148; PWA-4517) Avail: NTIS HC $9.25 CSCL 01C

A low speed, low noise, single stage fan was designed and tested. Design pressure ratio was 1.5 at a rotor tip speed of 1000 ft/sec. No inlet guide vane was used, the rotor stator was spaced and the number of rotor and stator airfoils was selected for low noise. Tests were conducted with uniform and distorted inlet flows. Stall margin of the initial design was too low for practical application. Airfoil slots and boundary layer and endwall devices did not improve stall margin sufficiently. A redesigned stator with reduced loadings increased stall margin, giving a fan efficiency of 0.883, 15% stall margin, and a 1.474 pressure radio at a specific flow of 41.7 lb/sec sq ft. Casing treatment over rotor tips improved stall margin with distorted inlet flow; vortex generators did not. Blade passing frequency noise increased with rotor relative Mach number. No supersonic fan noise was measured below 105% of design speed. Slotting airfoils, casing treatments, and a reduction of the ratio (number-stators/number-rotors) from (2n + 16) to (2n + 2) had no significant effects on noise. Author

N73-21071*# Systems Control, Inc., Palo Alto, Calif.
MAXIMUM LIKELIHOOD IDENTIFICATION AND OPTIMAL INPUT DESIGN FOR IDENTIFYING AIRCRAFT STABILITY AND CONTROL DERIVATIVES
David E. Stepner and Raman K. Mehra Washington NASA Mar. 1973 205 p refs
(Contract NAS1-10700)
(NASA-CR-2200) Avail: NTIS HC $3.00 CSCL 01B

A new method of extracting aircraft stability and control derivatives from flight test data is developed based on the

maximum likelihood criterion. It is shown that this new method is capable of processing data from both linear and nonlinear models, both with and without process noise and includes output error and equation error methods as special cases. The first application of this method to flight test data is reported for lateral maneuvers of the HL-10 and M2/F3 lifting bodies, including the extraction of stability and control derivatives in the presence of wind gusts. All the problems encountered in this identification study are discussed. Several different methods (including a priori weighting, parameter fixing and constrained parameter values) for dealing with identifiability and uniqueness problems are introduced and the results given. The method for the design of optimal inputs for identifying the parameters of linear dynamic systems is also given. The criterion used for the optimization is the sensitivity of the system output to the unknown parameters. Several simple examples are first given and then the results of an extensive stability and control derivative identification simulation for a C-8 aircraft are detailed. Author

N73-21072*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SMALL-SCALE NOISE TESTS OF A SLOT NOZZLE WITH V-GUTTER TARGET THRUST REVERSER
James R. Stone and Orlando A. Gutierrez Washington Apr. 1973 64 p refs
(NASA-TM-X-2758; E-7307) Avail: NTIS HC $3.00 CSCL 01C

The noise generated by a 2.26- by 11.43-cm slot nozzle with a V-gutter reverser, as well as some aerodynamic data on flow, thrust-reversal efficiency, and nozzle jet velocity decay, was studied. The experimental data are scaled up to sizes suitable for reversing the wing flow of a 45/400-kg augmentor-wing-type STOL airplane, yielding perceived noise levels well above the 95-PNdb design goal on the 152-m sideline. The reverser, in addition to being noisier than the nozzle alone, also had a more uniform directional distribution and more high frequency noise. The maximum overall sound pressure level and the effective sound power level both varied with the sixth power of nozzle jet velocity. Preliminary experiments indicated possible sideline noise reduction by shielding. Author

N73-21073*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A WIND TUNNEL FLIGHT CORRELATION OF APOLLO 16 SONIC BOOM
Frank Garcia, Jr., Raymond M. Hicks, and Joel P. Mendoza Feb. 1973 22 p refs
(NASA-TM-X-62073) Avail: NTIS HC $3.25 CSCL 20A

A correlation of sonic boom pressure signatures recorded during reentry of the Apollo 16 command module with wind-tunnel signatures extrapolated to flight distances was made for Mach numbers of 1.83 and 9.71. The flight pressure signatures were recorded by microphones located onboard ships positioned near the ground track, whereas the wind tunnel signatures were measured during a test of a 0.016-scale model of the command module. The agreement between estimates based on wind tunnel data and flight measurements was good at the tested Mach numbers. Author

N73-21074# Hydrospace Research Corp., San Diego, Calif.
ANALYSIS OF OPERATIONAL NOISE MEASUREMENTS IN TERMS OF SELECTED HUMAN RESPONSE NOISE EVALUATION MEASURES Final Report, Mar. - Dec. 1971
Carole S. Tanner and Ray E. Glass Dec. 1971 71 p refs
(Contract DOT-FA71WA-2555)
(FAA-RD-71-112) Avail: NTIS HC $5.75

A comparison between common aircraft noise measures such as composite perceived noise level (PNLC), maximum perceived noise level (PNLM), A-weighted level, D-weighted level and noise exposure level (NEL), and the corresponding effective perceived noise level (EPNL) has been made. Differences between EPNL and each of these measures were computed for the 727, KC-135, 707-320B, and DC-9 aircraft for three take-off and four approach operational procedures. Data is presented in both tabular and plotted form. Author

N73-21075# Institut Franco-Allemand de Recherches, St. Louis (France).
INVESTIGATION OF AXISYMMETRIC FREE SUPERSONIC JETS Ph.D. Thesis - Karlsruhe Univ. [UNTERSUCHUNG ROTATIONSSYMMETRISCHER UEBERSCHALLFREI-STRAHLEN]
H.-J. Pfeifer 30 Aug. 1972 104 p refs In GERMAN
(Contract T-0260-12630-11005)
(ISL-29/72) Avail: NTIS HC $7.25

The properties of a supersonic free jet emerging from a convergent or straight circular nozzle at overcritical pressure ratio into the free atmosphere were investigated. Of particular interest were the relations between jet structure and the discrete noise frequencies. The following methods were applied: conventional schlieren methods with low and high speed photography as well as stereoscopy; an electro-optics method using a continuous wave laser for determining the temporal spectrum of gas density variations; and acoustic measurements with microphones. A model is proposed for the formation of the noise frequencies. The experiments show that the acoustic feedback by the standing sound wave near the free jet forms an essential part of this model. ESRO

N73-21076# Defense Documentation Center, Alexandria, Va.
SUPERSONIC TRANSPORTS Report Bibliography, Oct. 1971 - Dec. 1971
Feb. 1973 172 p refs
(AD-755600; DDC-TAS-72-72) Avail: NTIS CSCL 01/3

The bibliography is a compilation of references on Supersonic Transports. Citations are numerically sequenced within each of the following thirteen major headings: I. General and Comprehensive Studies; II. Program Management and Financial Analysis; III. Airport Compatibility, Ground Operations, and Air Traffic Control; IV. Sonic Boom, Aircraft and Engine Noise; V. Aerodynamics; VI. Airframes: Structural Design and Analysis; VII. Airframes: Materials and Coatings; VIII. Systems: Electronic and Electrical; IX. Systems: Hydraulic; X. Systems: Environmental and Safety; XI. Systems: Engine Intake and Exhaust; XII. Systems: Engine Fuel, Control and Lubrication; and XIII. Engines. This document supersedes AD-853100 and AD-501950. Corporate Author-Monitoring Agency, Subject, Title, Personal Author, Contract, Report Number, and AD - Number Indexes are included. Author (GRA)

N73-21077# Army Foreign Science and Technology Center, Charlottesville, Va.
MATHEMATICAL SIMULATION OF FLIGHT DYNAMICS
S. I. Zlochevskii and Yu. D. Kuznetrov 25 Oct. 1973 11 p refs Transl. into ENGLISH from Vestn. Moscow Univ. (Moscow), no. 2, 1971 p 100-107
(AD-755868; FSTC-HT-23-2129-72) Avail: NTIS CSCL 01/3

The report is devoted to the investigation of equations of aircraft dynamics, their subdivision into two groups of equations and to the construction of an analog-digital complex on this basis. Author (GRA)

N73-21078# Systems Technology, Inc., Hawthorne, Calif.
AN ASSESSMENT OF THE PAPER PILOT - AN ANALYTICAL APPROACH TO THE SPECIFICATION AND EVALUATION OF FLYING QUALITIES Final Report, Dec. 1970 - Jun. 1972
Gary L. Teper Wright-Patterson AFB, Ohio AFFDL Jun. 1972 130 p refs
(Contract F33615-71-C-1071; AF Proj. 8219)
(AD-755367; STI-TR-1006-1; AFFDL-TR-71-174) Avail: NTIS CSCL 01/2

The Paper Pilot is an approach to flying qualities specification and evaluation based on pilot-vehicle system analysis. A fixed-base simulation program was conducted to test its application in the precision hover task. Pilot ratings and system performance measures and describing functions were obtained. An efficient technique was developed by which pilot model parameters were obtained from the describing function data. This provides a unique data base for a realistic, multi-loop (single-controller, multi-input) task. A comparison of the data with the predictions of the Paper Pilot indicate that the pilot model used should be expanded if improved predictions of pilot and system characteristics are to be obtained. Initial steps in this direction were taken but further developments are desirable. Author (GRA)

N73-21079# Bureau of Mines, Pittsburgh, Pa. Mining and Safety Research Center.
IGNITION AND FIRE SUPPRESSION IN AEROSPACE VEHICLES (PHASE 2) Technical Report, 1 Dec. 1971 - 30 Jun. 1972
Ralph J. Cato, George H. Martindill, and Joseph M. Kuchta Wright-Patterson AFB, Ohio AFAPL Dec. 1972 32 p
(Contract F33615-72-M-5008; AF Proj. 3048)
(AD-755362; PMSRC-4178; AFAPL-TR-72-96) Avail: NTIS CSCL 13/12

The effectiveness of Halons 1301 (CF3Br), 1202 (CF2Br2), and 1211 (CF2C1Br) as possible explosion suppressants for aircraft fuel tanks was investigated in ignitions with small charges of an IM-11 incendiary powder (Ba(NO3)2-Mg-Al) and 30-caliber incendiary ammunition. Ignitions with the incendiary powder in a 74-gallon fuel tank indicated that over 8 volume percent Halon 1301 is required to fully quench flame propagations of near-stoichiometric n-pentane-air mixtures and limit the pressure rises to less than 5 psi; such high Halon concentrations were also required under gun firing conditions using the 30-caliber ammunition. The critical Halon requirements for quenching the incendiary ignitions of n-pentane-air mixtures did not appear to differ greatly for the three Halons investigated in this work. Author (GRA)

N73-21080# Ohio State Univ. Research Foundation, Columbus.
ELECTRICAL CHARGING OF A CYLINDER BY A SEEDED VORTEX Interim Technical Report
Philip B. Bohl and H. R. Velkoff Oct. 1972 106 p refs
(Contract DA-31-124-ARO(D)-246)
(AD-755282; TR-15; AROD-4942-20-E) Avail: NTIS CSCL 01/3

It is a well-established fact that aircraft, especially helicopters, become electrically charged in particular conditions of flight, such as in the case of flying or hovering near particulate matter. The trailing vortices shed by each rotor tip, in the case of a helicopter, flow downward in a helical path and bathe the surface of the helicopter with the fluid field associated with the vortex. The purpose of this research work was to measure the electrical charging rate of a cylindrical body bathed by the trailing vortex shed by a different airfoil seeded with charged particulate in a subsonic wind tunnel. Author (GRA)

N73-21081# Hydrospace Research Corp., San Diego, Calif.
MEASUREMENT AND ANALYSIS OF NOISE FROM SEVENTEEN AIRCRAFT IN LEVEL FLIGHT (MILITARY, BUSINESS JET, AND GENERAL AVIATION) Final Report, Jun. 1970 - Nov. 1971
Carole S. Tanner Nov. 1971 68 p refs
(Contract DOT-FA70WA-2374)
(TR-S-212; FAA-RD-71-98) Avail: NTIS HC $5.50

Measurements of noise from aircraft level flyovers are presented in the form of effective perceived noise level (EPNL) as a function of slant range at the closest point of approach. Seventeen aircraft were investigated (various military, business jets, and general aviation types) and the effort involved acquisition of acoustical, meteorological, aircraft tracking, and aircraft operational data. Microphones were located near the ground in an array normal to the flight track. Author

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines, hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; Nuclear Engineering; and 28 Propulsion Systems.

N73-21082*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DIGITAL-COMPUTER PROGRAM FOR DESIGN ANALYSIS OF SALIENT, WOUND POLE ALTERNATORS
David S. Repas Washington Apr. 1973 88 p
(NASA-TN-D-7258; E-7244) Avail: NTIS HC $3.00 CSCL 10B

A digital computer program for analyzing the electromagnetic design of salient, wound pole alternators is presented. The program, which is written in FORTRAN 4, calculates the open-circuit saturation curve, the field-current requirements at rated voltage for various loads and losses, efficiency, reactances, time constants, and weights. The methods used to calculate some of these items are presented or appropriate references are cited. Instructions for using the program and typical program input and output for an alternator design are given, and an alphabetical list of most FORTRAN symbols and the complete program listing with flow charts are included. Author

N73-21083*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
EFFECTS OF ELECTRON IRRADIATION AND TEMPERATURE ON 1 ohm-cm AND 10 ohm-cm SILICON SOLAR CELLS
C. Nicoletta Mar. 1973 36 p refs
(NASA-TM-X-66231; X-765-73-87) Avail: NTIS HC $4.00 CSCL 10A

One ohm-cm and 10 ohm-cm silicon solar cells were exposed to 1.0 MeV electrons at a fixed flux of 10 to the 11th power e/sq cm/sec and fluences of 10 to the 13th power, 10 to the 14th power and 10 to the 15th power e/sq.cm. 1-V curves of the cells were made at room temperature, - 63 C and + or - 143 C after each irradiation. A value of 139.5 mw/sq cm was used as AMO incident energy rate per unit area. The 10 OHM-cm cells appear more efficient than 1 OHM-cm cells after exposure to a fluence greater than 10 to the 14th power e/sq cm. The 1.0 MeV electron damage coefficients for both 1 OHM-cm and 10 OHM-cm cells are somewhat less than those for previously irradiated cells at room temperature. The values of the damage coefficients increase as the cell temperatures decrease. Efficiencies pertaining to maximum power output are about the same as those of n on p silicon cells evaluated previously. Author

N73-21084# Sandia Labs., Albuquerque, N.Mex.
ADVANCEMENTS IN PELLET-TYPE THERMAL BATTERY TECHNOLOGY
D. M. Bush Oct. 1972 66 p refs Sponsored by AEC
(SC-RR-69-497-A) Avail: NTIS

The development of a prototype thermal battery incorporating a pelletized heat source is reported. Recent batteries, operating at a 61 percent higher current density, gave an average life of 13.8 minutes. The Ca/LiClKCl, CaCrO4/Fe system has been used throughout. Changes made to the battery design that have resulted in improved performance included a modified heat source, the use of bimetal anodes, a more efficient electrolyte immobilizer, special heat buffer pellets, new powder processing techniques, a light-weight container, and a new insulating material. Techniques have been devised to record cell stack temperatures during battery discharge. The investigations leading to these design changes are discussed and test results that have been obtained with recent control batteries are presented. Author

N73-21085# Catalyst Research Corp., Baltimore, Md.
HF CELL DEVELOPMENT
J. R. Moser May 1972 55 p Prepared for Sandia Corp., Albuquerque, N. Mex. Sponsored by AEC
(Contract SC-58-9945)
(SC-CR-72-3156) Avail: NTIS

The ability of the cathode material and the performance of the HF cell over a variety of operating conditions are outlined. The shelf storage stability of the mercuric cathode was observed for stand periods of one month. Electrodes were prepared with 3 different fillers, namely, silver powder, graphite powder, and dispersed liquid mercury. It was generally concluded that mercuric fluoride cathodes containing either silver powder or graphite powder do not deteriorate during the stand period. Least squares equations were used to relate electrode performance to its storage time. Based on the energy density calculated for each of a series of 108 tests, several parameters were defined that would optimize the cell performance. These conclusions were that: (1) tin anodes should be made for 170 mesh tin particles; (2) tin anode capacity should be 2500 ma/min. on a 0.75 in. diameter electrode; and (3) cathode capacity should be 2500 ma/min. on a 0.75 in. diameter electrode. Author

N73-21086# Hawker Siddeley Dynamics, Ltd., Hatfield (England). Space Div.
REPORT ON THE DESIGN PHASE OF THE CABLE BOOM DEVELOPMENT STUDY
R. H. Cox, comp. Oct. 1972 82 p Sponsored by ESRO
(HSD-TP-7356; ESRO-CR(P)-158) Avail: NTIS HC $6.25

The development tests and calculations made to support the design configuration of a cable boom are presented. Analysis of the stress, weight and thermal behavior aspects of the design are considered and the cable structure and drive mechanism discussed. A failure modes and effects analysis of the design evolved is also included. ESRO

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

N73-21087*+ National Aeronautics and Space Administration, Washington, D.C.
AEROSPACE MEDICINE AND BIOLOGY: A CONTINUING BIBLIOGRAPHY WITH INDEXES, SUPPLEMENT 112, FEBRUARY 1973
Feb. 1973 101 p refs
(NASA-SP-7011(112)) Avail: NTIS HC $3.00 CSCL 06E

This special bibliography lists 322 reports, articles, and other documents introduced into the NASA scientific and technical information system in January 1973. Author

N73-21088*# California Univ., Davis. Dept. of Human Physiology.
CIRCADIAN PHASE RELATIONSHIPS IN MONKEYS
R. El. Smith and D. R. Wekstein [1973] 12 p Prepared in cooperation with Kentucky Univ., Lexington
(Grants NGR-05-004-038; NGR-05-004-053)
(NASA-CR-131514)
Avail: NTIS HC $3.00 CSCL 06P

Two adult male pigtail monkeys were placed in an isolated, soundproofed chamber (entered for cleaning only) for a period of six months, during which time their deep body temperatures (T sub DB, telemetered from transmitters implanted in the abdominal cavity), fluid intake, urinary output (UV), urinary sodium and potassium were continuously monitored. During the first 3 1/2 months, lights (L) were turned on at 0000 hours, off at 1200 hours. Photoperiod phase was then delayed (light span prolonged) 6 hours to a new schedule: L on at 0600 hours, off at 1800 hours. Six weeks later, photoperiod phase was advanced 6 hours to return to the original schedule. Prior to shift, T sub DB typically began a steep rise 0-5 hours prior to L on, a steep fall 3-4 hours prior to L off, relative plateaus in between. Urinary Na typically peaks 2 hours prior to L off, has a minimum 2-4 hours prior to L on; K tends both to peak and show a minimum 2-8 hours earlier than Na; in contrast, UV peaks at L on, has a minimum 2-6 hours after L off. Upon delaying photoperiod phase, T sub DB shift was completed in 8 days. UV shifted more rapidly but tended to overshoot the new phase. Within 5 days, UV and K completed their shifts, although Na did not fully resynchronize within the 6-week period monitored. Author

N73-21089# Joint Publications Research Service, Arlington, Va.
MEDICAL, OTHER PROBLEMS OF SPACE FLIGHT
6 Apr. 1973 11 p refs Transl. into ENGLISH from Aviat. Kosmonavt. (Moscow), no. 1, 1973 p 28-29 and 32-33
(JPRS-58678) Avail: NTIS HC $3.00

Medical, biological and other problems of space flight are studied including the flight testing of cosmonaut safety equipment. For individual titles, see N73-21090 through N73-21091.

N73-21090 Joint Publications Research Service, Arlington, Va. **c05**
FIRST THE TESTERS FLY
E. Anisimov *In its* Med., Other Probl. of Space Flight 6 Apr. 1973 p 1-6 (For availability see N73-21089 12-04)

Problems in simulating weightlessness in aircraft are discussed for the tester and the cosmonaut. F.O.S.

N73-21091 Joint Publications Research Service, Arlington, Va.
MEDICAL AND BIOLOGICAL PROBLEMS OF SPACE FLIGHT
L. Khachaturyants and Ye. Khrunov *In its* Med., Other Probl. of Space Flight 6 Apr. 1973 p 7-9 refs (For availability see N73-21089 12-04)

A bibliography is briefly reviewed of Soviet and foreign journals devoted to medical and biological research conducted during space flights. F.O.S.

N73-21092# Advisory Group for Aerospace Research and Development, Paris (France).
PREDICTABILITY OF MOTION SICKNESS IN THE ELECTION OF PILOTS
M. P. Lansberg, ed. Feb. 1973 69 p refs Partly in ENGLISH; partly in FRENCH Proc. of Aerospace Med. Panel Specialist Meeting, Glasgow, 7 Sep. 1972
(AGARD-CP-109) Avail: NTIS HC $5.50

Susceptibility and factors contributing to motion sickness are examined. The Air Force and Navy tests for motion sickness predictions are described. Drugs that counteract the air sickness are considered. Blind fish responses to gravitational changes during parabolic flight are also studied. For individual titles, see N73-21093 through N73-21101.

N73-21093 Defence and Civil Inst. of Environmental Medicine, Downsview (Ontario).
MEASUREMENT OF SUSCEPTIBILITY TO MOTION SICKNESS
K. E. Money *In* AGARD Predictability of Motion Sickness in the Selection of Pilots Feb. 1973 4 p refs (For availability see N73-21092 12-04)

Three different bases were suggested for predicting susceptibility to motion sickness in a specific vehicle. These are (1) history of motion sickness, (2) susceptibility to motion sickness in a laboratory device, and (3) laboratory vestibular and other tests. These techniques were reviewed, and their usefulness was assessed. It was concluded that the laboratory vestibular and other tests are without practical value. Susceptibility to motion sickness laboratory devices and history of motion sickness were used and have significant predictive value. Consideration of these techniques for selection of aircrew candidates includes a comparison of the economic and other advantages of elimination of most air sickness problems and the disadvantages of the testing expense and the loss of some candidates who would not actually have had difficulty with motion sickness. Author

N73-21094 Centre d'Etudes et de Recherches de Medecine Aeronautique, Paris (France).
POSSIBILITY OF PREDICTING PREDISPOSITION OF MOTION SICKNESS IN THE SELECTION OF PILOTS [POSSIBILITE DE PREVOIR LA PREDISPOSITION AU MAL DES TRANSPORTS LORS DE LA SELECTION DES PILOTES]
G. Leguay, J. C. Hadni, M. Gouars, R. Gelly, and A. P. Gibert *In* AGARD Predictability of Motion Sickness in the Selection of Pilots Feb. 1973 9 p In FRENCH (For availability see N73-21092 12-04)

The medico-aeronautical basis of selecting pilot personnel in relation to motion sickness is outlined. Human factors, aeronautical factors, and natural evolution of motion sickness in the pilots are described in detail. Selection techniques cover neuromuscular, neurovegetative, and psychological examinations, and flight experience. Transl. by E.H.W.

N73-21095 Leicester Univ. (England). Dept. of Psychology
FACTORS CONTRIBUTING TO MOTION SICKNESS SUSCEPTIBILITY: ADAPTABILITY AND RECEPTIVITY
James Reason (Naval Aerospace Med. Res. Lab., Pensacola, Fla.) and Ashton Graybiel *In* AGARD Predictability of Motion Sickness in the Selection of Pilots Feb. 1973 15 p refs (For availability see N73-21092 12-04)

Evidence is presented to show that two perceptual factors, receptivity and adaptability, contribute to variation in motion sickness susceptibility. An attempt is made to integrate these two sources of variation into a neural mismatch theory of motion sickness. Two original studies are briefly reported. In the first, positive and significant relationships were obtained between measures of adaptability and (1) a personal history measure of

susceptibility, (2) loss of well-being during exposure to cross-coupled angular accelerations, and (3) a questionnaire measure of introversion. It was also found that adaptability and receptivity are unrelated factors, and that, of the two, adaptability exerted the most potent influence upon susceptibility. Yet, among slow adapters only, there was some evidence to show that receptivity contributed to individual differences in proneness. The second study was concerned with the long-term retention of protective adaptation. Author

N73-21096 Naval Aerospace Medical Research Lab., Pensacola, Fla.

ASSESSMENT OF REACTIONS TO VESTIBULAR DISORIENTATION STRESS FOR PURPOSES OF AIRCREW SELECTION

Fred E. Guedry and Rosalie K. Ambler *In* AGARD Predictability of Motion Sickness in the Selection of Pilots Feb. 1973 8 p refs (For availability see N73-21092 12-04)

Several tests were described which are useful for predicting individuals who will separate from air training because of airsickness and/or disabling anxiety toward flight. These tests are based on measures of immediate reactions to disorientation stress. It is desirable to have a futher diagnostic assessment of individuals to determine the underlying causes of differences in reactivity to disorientation stress and also to estimate the individual's likelihood of success in the light of other predictor variables. The disorientation stress tests significantly augment other aviator predictor variables, and they appear to be significantly correlated to several personality measures. A particular visual display and task were used that produced significantly more sickness than did other tasks during comparable vestibular stimulation. The test procedure was changed and a procedure was developed which appears practical for assessing individual differences in accommodation to intersensory conflict between the visual and vestibular systems. The changed procedure did not produce sickness, and the results indicate that a 57 percent mean improvement in visual performance during vestibular stimulation can occur after only a 10-minute habituation schedule. At least part of the improvement in visual performance appears attributable to increased visual control over vestibular reflex control of the eyes. Author

N73-21097 Naval Aerospace Medical Research Lab., Pensacola, Fla.

MOTION SICKNESS QUESTIONNAIRE AND FIELD INDEPENDENCE SCORES AS PREDICTORS OF SUCCESS IN NAVAL AVIATION TRAINING c05

Robert S. Kennedy *In* AGARD Predictability of Motion Sickness in the Selection of Pilots Feb. 1973 5 p refs (For availability see N73-21092 12-04)

The usefulness of two paper and pencil tests in predicting the likelihood of success in Naval aviation training is reported. Several years experience with a motion sickness questionnaire is reviewed; literature and theories related to motion sickness are surveyed; and a group-administered personality test is reported. The motion sickness questionnaire (MSQ) was empirically validated against an experimental procedure for producing motion sickness symptomatology (N = 100), and in a larger group (N = 802) scores on the questionnaire were statistically related to the likelihood of aviation training success. Refinements in the scoring improved the predictive ability of the MSQ (N = 660) and cross-validated successfully (N = 550). Author

N73-21098 School of Aerospace Medicine, Brooks AFB, Tex. Biodynamics Branch.

THE USAFSAM SELECTION, TEST, AND REHABILITATION PROGRAM OF MOTION SICK PILOTS c05

Patrick J. Dowd *In* AGARD Predictability of Motion Sickness in the Selection of Pilots Feb. 1972 10 p refs (For availability see N73-21092 12-04)

The USAF School of Aerospace Medicine biaxial stimulator was used to impose standardized Coriolis stimuli for the purpose of determining a subject's tolerance of this very disturbing stimulus. This test differentiates the nonsick (NS) individuals from the sick (S) ones within each peer group (navigators, pilots, and airman trainees) and is a valuable indicator of the level of resistance an individual has to Coriolis accelerations and as a selection tool for an individual's resistance to motion sickness. The results of this type of test (pilots: NS-299, S-51; navigators: NS-60, S-34; airman trainees: NS-91, S-19; pentathlon athletes: NS-14, S-0) can greatly assist in the overall selection of personnel in preflight, postflight, and in-training programs. Author

N73-21099 Centre de Medecine Aeronautique, Brussels (Belgium).

THE SELECTION AND SURVEILLANCE OF STUDENT PILOTS WITH MOTION SICKNESS IN THE BELGIAN ARMED FORCES [LA SELECTION ET LA SURVEILLANCE DU POINT DE VUE MAL DE L'AIR DES ELEVES-PILOTES DES FORCES ARMEES BELGES] c05

S. Tribel *In* AGARD Predictability of Motion Sickness in the Selection of Pilots Feb. 1972 3 p In FRENCH (For availability see N73-21092 12-04)

A method of selecting and observing student pilots of the Belgian Air Force is given. Based on this method, 1500 students were admitted to pilot school in 1960 and 1972. Of this number only 7 were eliminated for established cases of motion sickness. Transl. by E.H.W.

N73-21100 Institute of Aviation Medicine, Fuerstenfeldbruck (West Germany).

TEST RESULTS ABOUT THE EFFECTIVENESS OF METIXENUM APPLIED AGAINST MOTION SICKNESS c05

Christian Henning *In* AGARD Predictability of Motion Sickness in the Selection of Pilots Feb. 1973 4 p refs (For availability see N73-21092 12-04)

Thirty healthy subjects were tested in a spatial disorientation demonstrator (SDD) in order to compare the effectiveness of Metixenum and Meclocin under double blind comparison test conditions against motion sickness with statistical evaluation. Metixenum reduced all subjective symptoms significantly. Its efficacy was higher than that of Meclocin. Simultaneously recorded objective symptoms (post-rotatory vertigo sensation, heart rate, results of a walking balance test) were not significantly influenced. Author

N73-21101* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

RESPONSES OF BLIND FISH TO GRAVITATIONAL CHANGES AS ACHIEVED IN PARABOLIC FLIGHT

R. J. VonBaumgarten (Mich. Univ., Ann Arbor), G. L. Shillinger, Jr., and G. Baldright (Mich. Univ., Ann Arbor) *In* AGARD Predictability of Motion Sickness in the Selection of Pilots Feb. 1972 4 p refs (For availability see N73-21092 12-04)

Blind fish, during parabolic flight, display a measurable and consistent behavior. The most spectacular new behavioral response is the forward looping of blind fish in or near weightlessness. This response shows no measurable adaptation during the entire period of weightlessness of about 30 sec. During the entrance and exit of weightless parabolas (pushover and pullout) respectively, the fish assumes a forward tilted diving position. Parabolic flight with negative g in the range between 0 g and -1 g causes similar diving responses of the fish with the only difference being that the dive is directed toward the top of the fish tank. When the response to a g value less than 1 g is compared to the response to increased g load on the ground (escape of darting response) an essential difference is seen: higher horizontal acceleration or jerk on the ground causes fish to swim, or even dart, against the direction of inertial force; fish during weightless parabolas move into the direction of the inertial or gravitational force. Since the vestibular system of fish is homologous to that of man, the observed behavior of fish in weightless flight could help to better understand human performance and sensations in comparable situations. Author

N73-21102# Advisory Group for Aerospace Research and Development, Paris (France).

THE USE OF MEDICATION AND DRUGS IN FLYING PERSONNEL

Heinz S. Fuchs, ed. Feb. 1973 154 p refs Partly in ENGLISH; partly in FRENCH Proc. of Aerospace Med. Panel Specialist Meeting, Glasgow, 5-6 Sep. 1972
(AGARD-CP-108) Avail: NTIS HC $9.75

Drug effects on flight fitness and the evaluation, detection, and identification of drugs and alcohol in flying personnel are discussed. For individual titles, see N73-21103 through N73-21126.

N73-21103 Advisory Group for Aerospace Research and Development, Paris (France).
TECHNICAL EVALUATION REPORT, CONCLUSION, RECOMMENDATIONS
Heinz S. Fuchs *In its* The Use of Medication and Drugs in Flying Personnel Feb. 1973 13 p refs (For availability see N73-21102 12-04)

Inasmuch as flying effectiveness depends on an optimum degree of psychosomatic fitness, it is axiomatic that the need in a flyer for drugs should raise serious doubts as to his fitness to fly. Increasing age of the flying population is the major contributing factor since there is an increased incidence of disease commonly associated with aging. Improved diagnostic techniques and augmented information about normals and early disease have also had a significant influence upon both the types of problems evaluated and their disposition. The flight surgeon must keep well informed on all drugs, particularly newly accepted ones, so that no medication will be prescribed which might compromise flight safety. Individual susceptibility and hypersensitivity to drugs in general must always be considered. In certain situations drug therapy is warranted to prevent complications and to effect an improvement in long term prognosis. Another problem is acute illness, wherein drug therapy is warranted either to treat primarily the etiology of the disease or more frequently merely to control the symptoms in a self-limited condition. Author

N73-21104 Federal Aviation Administration, Washington, D.C. Office of Aviation Medicine.
THE CURRENT STATUS OF DRUG USE IN CIVIL AVIATION PERSONNEL
Peter V. Siegel and Stanley R. Mohler *In* AGARD The Use of Medication and Drugs in Flying Personnel Feb. 1973 4 p (For availability see N73-21102 12-04)

Screening data concerning U.S. civil airmen while being medically certified during the period July 1971 - April 1972 are reported. In the sample studied, two percent of pilots and three percent of ground control personnel had positive urines. The positives included barbiturates, amphetamines, codeine, morphine, and methadone. Author

N73-21105 Royal Air Force Hospital, Ely (England).
MEDICATION AND DRUGS IN AIRCREW
H. B. Kelly *In* AGARD The Use of Medication and Drugs in Flying Personnel Feb. 1973 4 p refs (For availability see N73-21102 12-04)

The attitudes adopted by the Royal Air Force and British civil aviation toward medication and drugs taken by their aircrew are discussed and recommendations made. Author

N73-21106 Royal Air Force Inst. of Aviation Medicine, Farnborough (England).
USE OF HYPNOTICS BY AIRCREW. 1: OPERATIONAL CONSIDERATIONS AND EXPERIMENTAL STUDIES
A. N. Nicholson and Catherine M. Wright *In* AGARD The Use of Medication and Drugs in Flying Personnel Feb. 1973 5 p refs (For availability see N73-21102 12-04)

The residual effects of hypnotic drugs for normalizing aircrew sleeping patterns on human nervous function and performance are studied. Delayed matching-to-sample tests on monkeys show that barbiturates do not affect matching-to-stimuli time; but some benzodiazepines increase response times up to 6 hrs after administration. G.G.

N73-21107 Air Corporations Joint Medical Service (BEA/BOAC), London (England).
ASPECTS OF SLEEP REGULATION IN AIRLINE PILOTS
F. S. Preston *In* AGARD The Use of Medication and Drugs in Flying Personnel Feb. 1973 8 p refs (For availability see N73-21102 12-04)

Probably the greatest problem facing long haul civil airlines is the need to ensure that pilots are given adequate time while on a tour of duty to ensure sufficient sleep and so enable them to cope successfully with the ensuing period of work. The problem on long haul routes is greatly compounded by the effect of time zone changes, night flights and changes of a climatic nature which all affect the individual's ability to achieve sleep on arrival. There is definite evidence of cumulative sleep loss on longer trans-meridian routes. As a result, the individual pilot may be tempted to use hypnotics which he can purchase freely over the counter in some parts of the world without medical supervision. In addition, he may use alcohol for its hypnotic action or combined with other hypnotics which may affect not only his fitness to fly on the next day, but have addictive and cumulative effects. The problems are discussed for a long haul airline and some suggestions are made for controlling the situation from both the medical and executive standpoints. Author

N73-21108 Royal Air Force Central Medical Establishment, London (England).
AVMED POLICY ON SLEEP IN AIRCREW
P. J. OConnor *In* AGARD The Use of Medication and Drugs in Flying Personnel Feb. 1973 2 p (For availability see N73-21102 12-04)

The role of the aviation medical practitioner in relation to aircrew sleep is to instruct the crews in how to anticipate sleep requirements and the best physiological ways of encouraging adequate sleep. Hypnotics should not be used by crews to get sleep as they cause decrement in performance during the subsequent day. Author

N73-21109 Royal Air Force Inst. of Aviation Medicine, Farnborough (England).
USE OF HYPNOTICS BY AIRCREW: ADAPTIVE TRACKING AS A TECHNIQUE FOR THE EVALUATION OF PERFORMANCE DECREMENTS RELATED TO THE FLYING TASK
R. C. Borland and A. N. Nicholson *In* AGARD The Use of Medication and Drugs in Flying Personnel Feb. 1973 5 p refs (For availability see N73-21102 12-04)

The mean performance of 6 subjects tested following the oral administration of secobarbitone at a dose of 3.3 mg/kg of body weight in an adaptive tracking task provides a reasonable approach to evaluating drug after-effects of possible significance to the flying task. Nevertheless, training of personnel and the experimental procedures involved demand considerable effort on the part of subjects and experimenters. Author

N73-21110 Centre d'Essais en Vol, Bretigny-sur-Orge (France).
MODIFICATIONS OF PERFORMANCE UNDER CERTAIN MEDICATIONS: PROPOSED MEASURING METHOD [MODIFICATIONS DE LA PERFORMANCE SOUS L'INFLUENCE DE CERTAINS MEDICAMENTS: A PROPOS D'UNE METHODE DE MESURE]
R. Auffret, R. Angiboust, and J. Demange *In* AGARD The Use of Medication and Drugs in Flying Personnel Feb. 1973 5 p refs In FRENCH (For availability see N73-21102 12-04)

The influence of tranquilizers, hypnotic drugs, and barbiturates on the performance of navigation personnel is investigated. Reaction time, personnel efficiency during complex tasks, and psychological factors were measured. It was determined that some drugs— Fluphenazine, Trifluopiperazine, and Prenylamine— do not affect performance, while hypnotic drugs and tranquilizers show some definite performance decrement. Transl. by E.H.W.

N73-21111 Army Aeromedical Research Lab., Fort Rucker, Ala.
THE EFFECTS OF INH CHEMOPROPHYLAXIS ON AVIATOR PERFORMANCE
Mark A. Hofmann *In* AGARD The Use of Medication and Drugs in Flying Personnel Feb. 1973 8 p refs (For availability see N73-21102 12-04)

A group of tuberculin positive, healthy aviators taking INH prophylactically at dosages of 300 mg. daily for one year were maintained on flying status while simultaneously participating in a study to determine the effects of this drug therapy. This investigation measured performance on a number of laboratory tasks to include pursuit tracking, mental multiplication, digit span, reaction time and combinations of the above. No decrements in performance were observed in this performance as a function of drug treatment. Additionally, these aviators' physical state was assessed by measuring a host of physiological parameters during their year of therapy. There was no evidence of severe drug reactions. It was recommended that aviators be allowed to continue flying duties while taking INH at these dosage levels, but in the interest of safety, a regular program of careful clinical observation and periodic measurements of transaminase levels be conducted. Author

N73-21112 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Bad Godesberg (West Germany). Inst. fuer Flugmedizin.

THE PREDICTION OF FLIGHT SAFETY HAZARDS FROM DRUG INDUCED PERFORMANCE DECREMENTS WITH ALCOHOL AS REFERENCE SUBSTANCE

Karl E. Klein *In* AGARD The Use of Medication and Drugs in Flying Personnel Feb. 1973 12 p refs (For availability see N73-21102 12-04)

A modification of CNS activity resulting in a decrement of performance is the most unwanted side effect of drugs in active flying personnel. A procedure is described where hazard prediction is accomplished with ethanol as reference substance through the following steps: (1) Evaluation of dose-effect-relationship for ethanol with the performance test to be applied in toxicological drug studies, and (2) Examination of drug with the alcohol calibrated test method; estimation of the alcohol intoxication level equipotential in its performance decrement to the drug dose studied; definition of the operational significance of the drug induced performance changes by reference to the intoxication-hazard-relationship established for alcohol; prediction of the critical drug dose through extrapolation. Results with sedative, neuroleptic, tranquilizing and stimulating drugs are demonstrated and the advantage and limitations of the reference procedure discussed. Author

N73-21113 Ohio State Univ., Columbus. Aviation Medicine Research Lab.

ETHYL ALCOHOL AND PILOT PERFORMANCE: MILITARY IMPLICATIONS OF IN-FLIGHT STUDIES

C. E. Billings, R. L. Wick, Jr., R. J. Gerke, and R. C. Chase *In* AGARD The Use of Medication and Drugs in Flying Personnel Feb. 1973 11 p refs (For availability see N73-21102 12-04)

Sixteen instrument-rated civil pilots flew 501 instrument landing system approaches in a light airplane at night under simulated instrument flight conditions while sober and while under the influence of .04, .08 and 12 G% blood ethyl alcohol concentrations. Data included continuous measurement of deviations from localizer and glide path centerline; note was made of all procedural errors. While the highly experienced pilots maintained better tracking performance than the less experienced subjects, particularly at high blood alcohol levels, both groups demonstrated progressive increases in the number and seriousness of procedural errors with each increase in alcohol level. These results indicate that alcohol-induced performance degradation may occur first in secondary tasks rather than in the primary flying task. They also indicate that there is potentially dangerous deterioration in the performance of even highly skilled aviators at blood alcohol levels as low as .04%. Author

N73-21114 Caen Univ. (France). Faculte de Medecine et de Pharmacologie.

THE OPTIMIZATION OF FORM [L'OPTIMISATION DE LA FORME]

Robert N. Lemaire *In* AGARD The Use of Medication and Drugs in Flying Personnel Feb. 1973 3 p In FRENCH (For availability see N73-21102 12-04)

Sports medicine, in relation to the effects of drugs on physical and psychological performance, is discussed. Three points were established for good physical form during competitive activities. They are: (1) maintenance of electrolytic equilibrium, (2) supplementation of normal vitamin levels, and (3) regulation of acid overloads. Transl. by E.H.W.

N73-21115 Mainz Univ. (West Germany). Inst. of Forensic Medicine.

DRUG USE AND PERFORMANCE

J. G. Gostomzyk, P. Parade, and H. Gewecke *In* AGARD The Use of Medication and Drugs in Flying Personnel Feb. 1973 5 p refs (For availability see N73-21102 12-04)

Psychological and physiological effects of acute cannabis intoxication are considered. It is shown that hashish smoking does not affect oxygen consumption in man. However, performance requirements in driving a car under the influence of the drug appear to be felt as stress which demands a response from a psychologically stimulated high energy level. Reduced performance capability manifests itself if actual stress situations are superimposed upon the normal task. It is concluded that hashish impairs the ability to drive safely. G.G.

N73-21116 BioTechnology, Inc., Falls Church, Va.

USE OF SPECTRAL ANALYSIS PROCEDURES FOR THE EVALUATION OF DRUG EFFECTS

James F. Parker, Jr. and Thomas W. Frazier (Walter Reed Army Inst. of Res., Washington, D. C.) *In* AGARD The Use of Medication and Drugs in Flying Personnel Feb. 1973 9 p refs (For availability see N73-21102 12-04)

The use of spectral analysis procedures in the study of drug effects is described in an attempt to develop a more sensitive and meaningful index of performance change. Spectral analysis procedures use time series data in which basic biorhythmicities in performance are identified and studied as the subject is exposed to a stress condition (drug administration). Oscillatory performance profiles are transformed from the time domain to power spectra. These spectra then are examined by means of statistical coherence estimates. Changes in the coherence of these biorhythms provide a measure of the extent to which the organization of a complex performance has been disrupted by the stress condition. Subjects were administered a tranquilizing drug (chlordiazepoxide) under double-blind conditions. A significant loss of coherence was found for the performance of a vigilance task. No change was found in the accompanying physiological measures, heart rate and rectal temperature. These results clearly show a drug induced desynchronization of performance in a human data processing activity. It is concluded that spectral analysis techniques may be of value as one tool in the complete evaluation of drug effects. Author

N73-21117 School of Aerospace Medicine, Brooks AFB, Tex.

DRUG ABUSE DETECTION EFFORTS

George D. Lathrop, Harold L. Kaplan, and Jack E. Wallace *In* AGARD The Use of Medication and Drugs in Flying Personnel Feb. 1973 4 p refs (For availability see N73-21102 12-04)

Operational efforts to detect drug abuse by mass-screening urinalysis are summarized. Particular emphasis is given to the current analytical methods used to detect opiates, barbiturates, and amphetamines. Advantages and disadvantages of available methodology are presented to provide rationale guidelines for establishing an accurate and forensically reliable toxicology laboratory. Methods of thin layer chromatography and gas-liquid chromatography offer unparalled detection accuracy for drugs of abuse, as well as a capability to analyze therapeutic levels of certain psychotropic drugs (tranquilizers, antihistamines) of specific concern in flying populations. Tandem research efforts to improve current methodology for the diethylamide of lysergic acid (LSD), tetrahydrocannibinols (THC), and methadone, and to develop new tests based on individual enzymatic changes, are briefly presented. Author

N73-21118 Royal Air Force Inst. of Aviation Medicine, Farnborough (England).

USE OF HYPNOTICS BY AIRCREW: CONSIDERATIONS OF METABOLISM AND EXCRETION

J. M. Clifford and J. H. Cookson *In* AGARD The Use of Medication and Drugs in Flying Personnel Feb. 1973 6 p refs (For availability see N73-21102 12-04)

The metabolism of secobarbitone, heptabarbitone and the nonbarbiturate hypnotic methaqualone have been studied in man using the technique of gas liquid chromatography. A polarographic technique for plasma levels of nitrazepam has also been investigated. Author

N73-21119 Institute of Aviation Medicine, Fuerstenfeldbruck (West Germany).

THE IMPACT OF DIURNAL RHYTHM ON DRUG DOSING AND DRUG EVALUATION

H. W. Kirchhoff *In* AGARD The Use of Medication and Drugs in Flying Personnel Feb. 1973 4 p (For availability see N73-21102 12-04)

The well known fact that the functional behavior of the human organism is subjected to a rhythmically occurring daily process is still being disregarded in clinical practice and pharmacology. Drug dosing, instead of sticking to the stereotyped pattern of 3 x 1 tablet/day, requires full consideration of the diurnal variations which occur in the human body involving mainly

cardiovascular parameters. Drug evaluation, on the other hand, should also include careful studies in diurnal rhythm in order to obtain precise data on the duration and onset of drug action as well as on specific influence emerging in the course of the day; all the more since any approach of this kind will contribute to the elimination of untoward side effects and other hazardous influences which may be attributed to a drug. Author

N73-21120 Hopital d'Instruction des Armees, Versailles (France).
ANTIDIABETIC MEDICATIONS AND NAVIGATION PERSONNEL [MEDICAMENTS ANTIDIABETIQUES ET PERSONNEL NAVIGANT]
Roger Pannier and Gerard Leguay *In* AGARD The Use of Medication and Drugs in Flying Personnel Feb. 1973 6 p In FRENCH (For availability see N73-21102 12-04)

The use of antidiabetic drugs and the fitness of such people as navigation personnel are examined. It was determined that the insulin-dependent sugar diabetic is unfit for such jobs because he is subject to keto-acidosic accidents, hypoglycemia, and regimented diets unsuited for his job. In non-insulin dependent diabetics who are maintained by oral drugs, it was determined that those who use sulphenylureas are also unsuited for flying duties since this drug sometimes causes hypoglycemia. Diabetics taking biguanide, it was determined, may under exceptional circumstances become or continue to be flying personnel. These drugs do not produce hypoglycemia as do the other medicants studied. Transl. by E.H.W.

N73-21121 Royal Air Force Hospital, Ely (England).
OCULAR SIDE EFFECTS OF DRUGS IN AVIATION MEDICINE
G. W. T. Smith *In* AGARD The Use of Medication and Drugs in Flying Personnel Feb. 1973 2 p (For availability see N73-21102 12-04)

Many drugs which may be prescribed for aircrew or used by aircrew in self medication have known reported ocular side effects which can affect visual performance. Reviewed are some of the main groups of these drugs, drawing attention to these side effects. Author

N73-21122 Advisory Group for Aerospace Research and Development, Paris (France).
OPHTALMOLOGIC SURVEILLANCE OF ABSORBED ANTIMALARIA DRUGS IN SYSTEMS OF NAVIGATION PERSONNEL [SURVEILLANCE OPHTALMOLOGIQUE DU PERSONNEL NAVIGANT ABSORBANT DES ANTIPALUDEENS DE SYNTHESE]
J. P. Chevaleraud (CPEMPN, Paris) *In its* The Use of Medication and Drugs in Flying Personnel Feb. 1973 5 p In FRENCH (For availability see N73-21102 12-04)

Observations of synthetic antimalarials, through opthalmological methods, in the systems of navigation personnel were made. Risks to test subjects and toxic side effects are discussed. Transl. by E.H.W.

N73-21123 Flugzeugfuehrerschule, Klein Heidorn (West Germany).
TRANQUILIZERS AND AVIATION
Heinrich Schulte-Wintrop *In* AGARD The Use of Medication and Drugs in Flying Personnel Feb. 1973 4 p refs (For availability see N73-21102 12-04)

The use of tranquilizers during periods of flying duty is still infrequent and no direct effects on flight safety have so far been positively observed; there is, however, a danger of such effects in case of excess dosage and use of ataractics such as diazepam. A potentiating effect by alcohol has been described in some cases, but the influence of alcohol alone appears to be the crucial factor in these cases. It is shown that ataractics like chlordiazepoxide fail to alleviate stress reactions in student pilots, but that the application of certain tranquilizers in treating different types of kinetosis seems promising. The prescription of tranquilizers should be avoided until the effects these medicaments have in combination with the varied strains encountered in avaiation have been fully surveyed. Author

N73-21124 Fighter Bomber Wing (31st), Kerpen/Erft (West Germany).
USE OF MEDICATION AND DRUGS, ESPECIALLY ALCOHOL BY FLYING PERSONNEL
Hugo Hembach *In* AGARD The Use of Medication and Drugs in Flying Personnel Feb. 1973 5 p refs (For availability see N73-21102 12-04)

Alcohol is the most common and most dangerous drug used by pilots. Three simple methods are described by which the blood alcohol can be determined: (1) By means of two tables pilots are able to determine the approximate level of blood alcohol concentration after the consumption of a known amount of alcoholic beverage over a given period of time; (2) the detection of the gross post-rotational nystagmus which is found whenever the central nervous system has been affected by alcohol; and (3) a semi-quantitative method of breath analysis for alcohol detection in the blood. These three methods make it possible to single out pilots who have alcohol in their blood and to prevent them from flying. Author

N73-21125 Centre d'Essais en Vol, Bretigny-sur-Orge (France).
EFFECT OF ALTITUDE ON CEREBRAL BLOOD FLOW PATTERNS IN THE SMOKER AND NONSMOKER [ACTION DE L'ALTITUDE, CHEZ LE FUMEUR ET LE NON FUMEUR, SUR LES VARIATIONS DU DEBIT SANGUIN CEREBRAL]
J. Demange and R. Auffret *In* AGARD The Use of Medication and Drugs in Flying Personnel Feb. 1973 5 p refs In FRENCH (For availability see N73-21102 12-04)

Variations in the cerebral blood circulation of smokers and nonsmokers as a function of altitude are measured rheographically. Also measured were the effects of vasometric drugs, altitude tolerance, chronic hypoxia, and performance as influence by blood flow. Transl. by E.H.W.

N73-21126 Institute of Pharmacology, Oslo (Norway).
COMPARISON OF MENTAL AND PSYCHOMOTOR EFFECTS OF DIAZEPAM AND ETHANOL
J. F. W. Haffner et al *In* AGARD The Use of Medication and Drugs in Flying Personnel Feb. 1973 10 p refs (For availability see N73-21102 12-04)

Whether and to what extent a single, large therapeutic dose of diazepam affects mental and psychomotor functions in man was determined. The effects of diazepam in dosages of 10 and 20 mg/70 kg body weight have been compared with those of alcohol in amounts which were designed to produce blood levels of approximately 0.1%. Serum concentrations of diazepam were estimated in order to see whether it was possible to establish a correlation between dosages, serum concentrations and effects. It was shown that diazepam has a negative influence on the results of a series of tests with relevance to performance. In none of the tests was there any improvement in mean score after diazepam compared with placebo. However, a comparison of the test results reveals some differences between the effects of alcohol and diazepam. Author

N73-21127*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
MICROBIOLOGICAL ASSAY OF THE MARSHALL SPACE FLIGHT CENTER NEUTRAL BUOYANCY SIMULATOR
F. J. Beyerle 16 Feb. 1973 57 p refs
(NASA-TM-X-64736) Avail: NTIS HC $5.00 CSCL 06M

A neutral buoyancy simulator tank system is described in terms of microbiological and medical safety for astronauts. The system was designed to simulate a gravity-free state for evaluation of orbital operations in a microorganism-free environment. Methods for the identification and elimination of specific microorganisms are dealt with as measures for a pure system of space environment simulation. J.M.M.

N73-21128*# Scientific Translation Service, Santa Barbara, Calif.
EXPERIENCE WITH THE METHOD OF GRABECKI AND COWORKERS FOR THE DETERMINATION OF URINE DELTA-AMINOLEVULINIC ACID IN THE PREVENTION OF LEAD POISONING
W. Mueller and G. Holzapfel Washington NASA Apr. 1973 9 p refs Transl. into ENGLISH from Int. Arch. Gewerbepathol. Gewerbehyg. (Berlin), v. 25, 1969 p 287-291
(Contract NASw-2483)
(NASA-TT-F-14864) Avail: NTIS HC $3.00 CSCL 06P

A method for the rapid determination of delta-ALA in urine given by Grabecki and coworkers is described. This method is

less expensive than the method of Mauzerall and Granick and therefore available in screening of lead-exposed workers. According to this method proposals are made in order to establish the normal values and the acceptable limit values of delta-ALA excretion in urine. Author

N73-21129*# Scientific Translation Service, Santa Barbara, Calif.
PSYCHOLOGICAL CHARACTERISTICS OF THE ACTIVITY OF COSMONAUTS
A. A. Leonov and V. I. Lebedev Washington NASA Mar. 1973 391 p refs Transl. into ENGLISH of the book "Psikhozogicheskiye Osobennosti Deyatelnosti Kosmonavtov" Moscow, Nauka Press, 1971
(Contract NASw-2035)
(NASA-TT-F-727) Avail: NTIS HC $6.00 CSCL 05J

The role of the cosmonaut in the man-spacecraft system is discussed along with the importance of crew teamwork in controlling multiplace spacecraft, and the psychological aspects of training cosmonauts as operators. The changes in the environmental conditions and the associated psychophysiological mechanisms of space and time perception away from the earth as man goes into outer space are shown. The influences of weightlessness, extended isolation in cramped quarters, emotional stress, and other space factors on man are explained. Man's motor activity under weightless conditions is analyzed. The possible gains from integrating man and machine and orientation training for cosmonauts, and from organizing work and rest periods for long space flights are emphasized. Author

N73-21130# Defence Research Information Centre, Orpington (England).
THE EFFECT OF SOME RADIOPROTECTIVE PREPARATIONS ON THE MOTOR AND EVACUATOR FUNCTION OF THE GASTROINTESTINAL TRACT OF HEALTHY AND IRRADIATED RATS
N. G. Krashnykh, L. A. Tyutin et al Dec. 1972 11 p refs Transl. into ENGLISH from Probl. Kosmich. Biol., v. 14, 1971 p 57-65
(DRIC-Trans-2962; BR-30326) Avail: NTIS HC $3.00

The experimental findings of a comparative study of the action of some of the more effective antiradiation drugs, cystamine, beta-ammoethylisothiuonium (AET), monosodiumbeta-ammoethyl thiophosphate (crystafos) and 5-methoxytryptamine (5-MOT), on the motor and evacuator functions of the gastrointestinal tract in healthy and irradiated white rats are presented. The preparations studied were administered orally, intraperitoneally, and rectally and it was found the substances slowed up evacuation of the contrast medium from the stomach. They also produced prolonged spasm of the pylonis and prephlonic part of the stomach as well as phasic disturbances of tone and penstalsis. The oral administration of the substances leads as a rule to a reduction in their protective properties. ESRO

N73-21131*# California Univ., Berkeley. Dept. of Statistics.
PROCEEDINGS OF THE 6TH BERKELEY SYMPOSIUM ON MATHEMATICAL STATISITICS AND PROBABILITY. VOLUME 5: DARWINIAN, NEO-DARWINIAN, AND NON-DARWINIAN EVOLUTION
Lucien M. LeCam, ed., Jerzy Neyman, ed., and Elizabeth L. Scott, ed. 1972 385 p refs Symp. held at Berkeley, Calif., 9-12 Apr. 1971 Sponsored in part by NSF, NIH, Army, and Navy
(Grants NGR-05-003-020; AF-AFOSR-1951-70; AF Proj. 9769)
(NASA-CR-131508; LC-49-8189; AD-754709; AFOSR-73-0116TR; ISBN-0-520-02188-6-Vol-5) Avail: NTIS HC $21.25 CSCL 06/3

Contents: Darwinian and non-Darwinian evolution theory; DNA, RNA, amino acid sequences; Population studies and evolution; Role of theory in evolutionary studies. GRA

N73-21132*# Naval Aerospace Medical Research Lab., Pensacola, Fla.
DOSIMETRIC CHARACTERISTICS OF HZE PARTICLES IN SPACE
Herman J. Schaefer 15 Nov. 1972 31 p refs
(NASA Order W-13280)
(NASA-CR-131467; Rept-47; AD-754427; NAMRL-1172) Avail: NTIS HC $3.75 CSCL 06/18

HZE particles, i.e., galactic heavy primaries with very high values of Linear Energy Transfer (LET) pose a special radiation hazard on manned space missions. While cellular destruction by single hits has been demonstrated, more general data on dose/effect relationships are not available since conventional concepts and units of radiation dosimetry are not applicable. The report summarizes existing knowledge on the energy spectrum of galactic heavy primaries and analyzes the microdosimetric pattern of energy dissipation in tissue. It is shown that the LET distribution shows a steep negative slope with the frequency of events decreasing steeply with increasing LET down to less than one event per cc tissue per day at 4000 kev/micron tissue. Assessing the HZE particle hazard requires new approaches in both radiobiological experimentation and dosimetric instrumentation. Author (GRA)

N73-21133# California Univ., Davis. Dept. of Human Physiology.
SYSTEMS ANALYSIS OF PHYSIOLOGICAL PERFORMANCE RELATED TO STRESSES SUCH AS THOSE EXPERIENCED IN HIGH PERFORMANCE AIR CRAFT Summary Report, 1 Oct. 1971 - 30 Sep. 1972
Richard F. Walters 30 Sep. 1972 39 p refs
(Contract F44620-72-C-0011; AF Proj. 9777)
(AD-754970; AFOSR-73-0026TR) Avail: NTIS CSCL 06/19

Areas of USAF interest discussed in the report are: Continued refinement of a predictive model of human performance; Maintenance of indexed bibliographies of performance, peripheral circulation and energy exchange for distribution to interested researchers in other Air Force related research centers; Collection of exercise performance data on normal and athletic subjects, as well as initiating data collecting on certain types of patients with specific problems such as pulmonary or circulatory diseases; Development of a comprehensive data support system for research in human physiology; Development of a joint investigation of acceleration (in conjunction with investigators at the School of Aerospace Medicine, Brooks Air Force Base, San Antonio, Texas); Installation of programs developed at this center in other Air Force research centers, including the U.S. Air Force Academy and an Air Force supported research project at the University of Kentucky; Data analysis and interpretation, using tools developed at Davis, for other research units; Joint research with the Air Academy. Author (GRA)

N73-21134# Naval Aerospace Medical Research Lab., Pensacola, Fla.
OPERANT BEHAVIOR OF RHESUS MONKEYS IN THE PRESENCE OF EXTREMELY LOW FREQUENCY LOW INTENSITY MAGNETIC AND ELECTRIC FIELDS, EXPERIMENT 1
John De Lorge 1 Nov. 1972 22 p refs
(MF1524015)
(AD-754058; NAMRL-1155) Avail: NTIS CSCL 06/18

The present study was one of several designed to measure specific operant behaviors and discover effects of exposure of animals to extremely low frequency magnetic and electric fields of low intensity in support of the U.S. Navy's attempt to scientifically explore the biological effects of these fields. Measurements of immediate memory, operant responding, and reaction time were obtained on two rhesus monkeys. No significant changes could be related to the exposure of these animals to a magnetic field of 10 gauss at 75 Hz or to the magnetic field combined with an electric field of 4 V/m at 75 Hz. The results provide supportive evidence that these specific electromagnetic fields have no general behavioral influence on nonhuman primates. Author (GRA)

N73-21761* Johann-Wolfgang-Goethe-Universitat, Frankfurt am Main (West Germany).
BIOMEDICAL EXPERIMENTS. PART A: BIOSTACK EXPERIMENT
Horst Buecker, G. Horneck, E. Reinholz (Max Planck Inst. fuer Biophys., Frankfurt), W. Scheuermann (Tech. Hochschule, Hanover), W. Ruether (Marburg Univ.), E. H. Graul (Marburg Univ.), H. Planel (Toulouse Univ.), J. P. Soleilhavoup (Toulouse Univ.), P. Cuer (Strasbourg Univ.), R. Kaiser (Strasbourg Univ.) et al *In* NASA. Lyndon B. Johnson Space Center Apollo 16 Prelim. Sci. Rept. 1972 10 p refs (For availability see N73-21729 12-30)
CSCL 06B

N73-21762* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
MICROBIAL RESPONSE TO SPACE ENVIRONMENT, PART B
G. R. Taylor, C. E. Chassay, W. L. Ellis (Northrop Serv., Inc.), B. G. Foster (Tex. A&M Univ.), P. A. Volz (Eastern Mich. Univ.), J. Spizizen (Scripps Clinic and Res. Found.), H. Buecker (Frankfurt Univ.), R. T. Wrenn (Northrop Serv., Inc.), R. C. Simmonds, R. A. Long (Northrop Serv., Inc.) et al *In its* Apollo 16 Prelim. Sci. Rept. 1972 6 p (For availability see N73-21729 12-30)
CSCL 06M

N73-21763* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
VISUAL LIGHT FLASH PHENOMENON, PART C
Richard E. Benson and Lawrence S. Pinsky *In its* Apollo 16 Prelim. Sci. Rept. 1972 4 p refs (For availability see N73-21729 12-30)
CSCL 06P

05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N73-21135 California Univ., Los Angeles.
STUDY OF ELECTROCUTANEOUS PARAMETERS RELEVANT TO DYNAMIC TACTUAL COMMUNICATION SYSTEMS Ph.D. Thesis
Ronald Edwin Prior 1972 241 p
Avail: Univ. Microfilms Order No. 72-20469

Data are presented on fundamental knowledge about relevant parameters in an electrocutaneous communication system, and applied knowledge related to the design and development of dynamic tactual communication systems, especially those for the reception of speech of visual images. Basic terms are defined and several applications of the dynamic system are presented. Electrode configurations and the resulting fields in the skin, skin preparation and electrode mounting procedures, polarization, spontaneous local breakdown, and the electrocutaneous stimulation amplifier are discussed in detail.
Dissert. Abstr.

N73-21136*# Tennessee Univ., Tullahoma. Space Inst.
CYBERNETIC INTEGRATION OF EXPERIMENTS INTO THE CVT SYSTEM Final Report
T. C. Helvey 31 Oct. 1972 40 p refs
(Contract NGR-43-001-117)
(NASA-CR-124150) Avail: NTIS HC $4.00 CSCL 05E

The research to develop a cybernetic model which is a static aggregate of the existing interaction in the CVT is reported. The experiments involving man considered necessary for cybernetic integration are listed. Topics discussed include: the modeling dynamic interactions for two competing systems; aspects of man-man integration in the CVT; and establishment of optimum number of research crew for the CVT. F.O.S.

N73-21137*# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.
COST ANALYSIS OF OXYGEN RECOVERY SYSTEMS
M. M. Yakut 28 Feb. 1973 57 p
(Contract NAS8-28377)
(NASA-CR-124175; MDC-G4128) Avail: NTIS HC $5.00 CSCL 06K

Report is made of the cost analysis of four leading oxygen recovery subsystems which include two carbon dioxide reduction subsystems and two water electrolysis subsystems, namely, the solid polymer electrolyte and the circulating KOH electrolyte. The four oxygen recovery systems were quantitatively evaluated. System characteristics, including process flows, performance, and physical characteristics were also analyzed. Additionally, the status of development of each of the systems considered and the required advance technology efforts required to bring conceptual and/or pre-prototype hardware to an operational prototype status were defined. Intimate knowledge of the operations, development status, and capabilities of the systems to meet space mission requirements were found to be essential in establishing the cost estimating relationships for advanced life support systems. Author

N73-21138*# ABT Associates, Inc., Cambridge, Mass.
NASA'S CONTRIBUTIONS TO PATIENT MONITORING, APPENDIX
Donald M. Murray and Warren D. Siemens 1971 122 p refs Sponsored by NASA
(NASA-CR-131538) Avail: NTIS HC $8.25 CSCL 06B

Health care problems and markets for patient monitoring equipment are discussed along with contributions to all phases of patient monitoring, and technology transfer to nonaerospace problems. Health care medical requirements, and NASA achievements in patient monitoring are described, and a summary of the technology transfer is included. F.O.S.

N73-21139*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE 1972 SUMMER INSTITUTE FOR BIOMEDICAL ENGINEERING Final Report, 19 Jun. - 25 Aug. 1972
Eugene M. DeLoatch (Howard Univ.) Feb. 1973 184 p refs Prepared in cooperation with Howard Univ., Washington, D. C. (Contract NASw-2386)
(NASA-TM-X-66214; X-207-73-73) Avail: NTIS HC $11.25 CSCL 06B

Biomedical engineering and design work is reported for hemoglobin tester, flow ventilation systems, hematological viscometer, isotope safe handling system, and strain gage blood pressure measuring device. For individual titles, see N73-21140 through N73-21144.

N73-21140* Federal City College, Washington, D.C.
DESIGN MODIFICATION OF ELECTROPHORETIC EQUIPMENT
Judy M. Reddick and Irvin Hirsch (City Coll. of the City of New York) *In* NASA. Goddard Space Flight Center The 1972 Summer Inst. for Biomed. Eng. Feb. 1973 p 9-39 refs Prepared in cooperation with City Coll. of the City of New York (For availability see N73-21139 12-05)
CSCL 06B

The improved design of a zone electrophoretic sampler is reported that can be used in mass screening for hemoglobin S, the cause of sickle cell anemia. Considered is a high voltage multicell cellulose acetate device that requires 5 to 6 minutes electrophoresis periods; cells may be activated individually or simultaneously. A multisample hemoglobin applicator standardizes the amount of sample applied and transfers the homolysate to the electrical wires. G.G.

N73-21141* Lehigh Univ., Bethlehem, Pa.
OPERATING ROOM ENVIRONMENT CONTROL. PART A: A VALVE CANNISTER SYSTEM FOR ANESTHETIC GAS ADSORPTION. PART B: A STATE-OF-THE-ART SURVEY OF LAMINAR FLOW OPERATING ROOMS. PART C: THREE LAMINAR FLOW EXPERIMENTS
Joseph S. Meyer and Judy Kosovich (Wis. Univ., Madison) *In* NASA. Goddard Space Flight Center The 1972 Summer Inst. for Biomed. Eng. Feb. 1973 p 41-104 refs Prepared in cooperation with Wis. Univ., Madison (For availability see N73-21139 12-05)
CSCL 06B

An anesthetic gas flow pop-off valve canister is described that is airtight and permits the patient to breath freely. Once its release mechanism is activated, the exhaust gases are collected at a hose adapter and passed through activated coal for adsorption. A survey of laminar air flow clean rooms is presented and the installation of laminar cross flow air systems in operating rooms is recommended. Laminar flow ventilation experiments determine drying period evaporation rates for chicken intestines, sponges, and sections of pig stomach. G.G.

N73-21142* Howard Univ., Washington, D.C.
HEMATOLOGICAL VISCOMETRY
Delma R. West and Charles H. Smoot, III (Purdue Univ.) *In* NASA. Goddard Space Flight Center The 1972 Summer Inst. for Biomed. Eng. Feb. 1973 p 105-140 ref Prepared in cooperation with Purdue Univ., Lafayette, Ind. (For availability

see N73-21139 12-05)
CSCL 06B

Concepts and defining equations for the design of a relative velocity blood viscometer are reported. The device consists of two cone and plate chambers, a variable speed drive, and rotational velocity detectors. Two cone-plate systems are directly coupled with one system driving the other through the viscous drag transmitted in the test fluid. Angular velocity measurements are processed electronically. A brief description of current viscometer designs is included. G.G.

N73-21143* Rose-Hulman Inst., Terra Haute, Ind.
HANDLING SYSTEM FOR IRIDIUM-192 SEEDS
Walter Carpenter and David Wodicka *In* NASA. Goddard Space Flight Center The 1972 Summer Inst. for Biomed. Eng. Feb. 1973 p 141-171 refs (For availability see N73-21130 12-05)
CSCL 06R

A complete system is proposed for safe handling of iridium-192 seeds used to internally irradiate malignant growths. A vibratory hopper feeds the seeds onto a transport system for deposit in a magazine or storage area. A circular magazine consisting of segmented plastic tubing with holes in the walls to accommodate the seeds seems feasible. The magazine is indexed to stop and release a seed for calibration and deposition. G.G.

N73-21144* Rensselaer Polytechnic Inst., Troy, N.Y.
INDIRECT BLOOD PRESSURE MEASURING DEVICE
Larry Hum and Clifton E. Cole (Howard Univ.) *In* NASA. Goddard Space Flight Center The 1972 Summer Inst. for Biomed. Eng. Feb. 1973 p 173-186 refs Prepared in cooperation with Howard Univ., Washington, D. C. (For availability see N73-21139 12-05)
CSCL 06B

Design and performance of a blood pressure recording device for pediatric use are reported. A strain gage transducer with a copper-beryllium strip as force sensing element is used to monitor skin movements and to convert them into electrical signals proportional to those displacements. Experimental tests with this device in recording of force developed above the left femoral artery of a dog accurately produced a blood pressure curve. G.G.

N73-21145# Control Data Corp., St. Paul, Minn.
AIR-TO-AIR VISUAL DETECTION DATA Interim Report
Apr. 1973 38 p refs
(Contract DOT-FA70WA-2263)
(FAA-RD-73-40) Avail: NTIS HC $4.00

Tests were conducted to determine ability of pilots to visually detect other aircraft in an air-to-air situation. The tests were based on the requirement to detect potentially hazardous intruders in the pilot warning instrument (PWI) concept. It was concluded that there is a high likelihood of seeing the intruder aircraft in sufficient time to take evasive action under visual flight rule conditions if the pilot is given accurate information on the location of the aircraft. For individual titles, see N73-21146 through N73-21148.

N73-21146 Federal Aviation Administration, Washington, D.C.
SUMMARY OF AIR-TO-AIR VISUAL DETECTION DATA, PART 1
A. Millhollon *In* Control Data Corp. Air-to-Air Visual Detection Data Apr. 1973 8 p (For availability see N73-21145 12-05)

An analysis of tests conducted to determine the ability of pilots to visually identify aircraft in an air-to-air situation in time to take evasive action and avoid collisions is presented. Specific cases of near collisions are cited to show the feasibility of collision avoidance by visual perception. Tentative conclusions concerning the potential performance of pilots aided by a pilot warning indicator are discussed. Author

N73-21147 Control Data Corp., St. Paul, Minn. Advance Systems Lab.
SUMMARY OF VISUAL DETECTION DATA, PART 2
J. Lyons *In its* Air-to-Air Visual Detection Data Apr. 1973 19 p ref (For availability see N73-21145 12-05)
(CDC-JL-5)

Flights were conducted in which two aircraft set out on collision or near-miss courses in order to provide photographic data for use in a simulator. In addition to photography in each run, data on the time and range of first visual detection of each aircraft by the crew of the other aircraft were recorded. The data provide a basis for determining the feasibility of midair collision avoidance based on the capability of pilots to visually perceive other aircraft. The run condition and data obtained are summarized in tabular form. Author

N73-21148 Control Data Corp., St. Paul, Minn. Advanced Studies Lab.
SUMMARY OF VISUAL DETECTION DATA TAKEN DURING THE ATA/CAS FLIGHT TESTS
W. Graham *In its* Air-to-Air Visual Detection Data Apr. 1973 10 p refs (For availability see N73-21145 12-05)

Flight tests were conducted to obtain data concerning the range of visual detection in air-to-air situations. Details of the equipment used and a summary of each flight are given. The geometrical aspects of the flights are analyzed numerically. The data are presented in the form of tables and graphs. Author

N73-21149# Joint Publications Research Service, Arlington, Va.
SPACEFLIGHT SAFETY
Yu. Tyurin and A. Rudev 18 Apr. 1973 7 p Transl. into ENGLISH from Aviat. Kosmonavt. (Moscow), no. 2, 1973 p 38-39
(JPRS-58781) Avail: NTIS HC $3.00

A review is presented of the safety problems facing man during space flight including radiation danger, contamination of space and rescue spaceships. Author

N73-21150*# Translation Consultants, Ltd., Arlington, Va.
ERGONOMICS PRINCIPLES AND RECOMMENDATIONS, NO. 2
G. M. Zarakovskiy, ed., V. M. Medjedev, and V. M. Munipov Washington NASA Apr. 1973 226 p refs Transl. into ENGLISH of the book "Ergonomika: Printsipy i Rekomendatsii, vyp. 2" Moscow, 1971 224 p
(Contract NASw-2038)
(NASA-TT-F-14888) Avail: NTIS HC $13.50 CSCL 05E

The psychophysiological analysis of man's job performance was studied to improve the ergonomic culture of artist-designers; and technical specialists. Topics discussed include: principles of the ergonomic descriptions of operator performance; methods of ergonomic analysis of performance under production conditions; selection, education, and training of operators for the man/machine system; objective monitoring of the level of training of operators in the man/machine system; and psychological stress of space flight. F.O.S.

N73-21151*# Texas Technological Univ., Lubbock.
INSULATED ELECTROCARDIOGRAPHIC ELECTRODES Patent Application
Robert M. David and William M. Portnoy, inventors (to NASA) Filed 4 Apr. 1973 22 p Sponsored by NASA
(NASA-Case-MSC-14339-1; US-Patent-Appl-SN-347953) Avail: NTIS HC $3.25 CSCL 06B

An insulated, capacitively coupled electrode for sensing bioelectric potentials or signals is reported. The electrode can be employed without a paste electrolyte to the body for extended usage without producing skin reactions. Its integrated system includes an impedance performer for the acquisition of electrocardiographic data that is encapsulated by a thin layer of non-toxic dielectric material. NASA

N73-21152*# Kanner (Leo) Associates, Redwood City, Calif.
SOME CONSTRUCTION PRINCIPLES FOR REMOTE CONTROL IMITATIVE MANIPULATORS
A. Ye. Bor-Ramenskiy, V. S. Kuleshov, N. A. Lakota, and V. I. Lobachev Washington NASA Apr. 1973 17 p refs Transl. into ENGLISH from Mekh. Mashin (USSR), no. 1/8, 1967 p 33-42
(Contract NASw-2481)
(NASA-TT-F-14889) Avail: NTIS HC $3.00 CSCL 05H

Some basic mechanical requirements for the construction of manipulators designed to perform a wide range of complex tasks at a distance from the operator are reviewed. The kinematics and dynamics of the human arm and hand are outlined, and

relevant construction principles are abstracted. These principles are then, rather effectively, applied to imitative remote control manipulators with both action and passive feedback. Author

N73-21153# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Inst. fuer Physik der Atmosphaere.
RESEARCH AT THE DFVLR IN THE FIELD OF ENVIRONMENTAL PROTECTION. PART 2: NOISE ABATEMENT, WATER AND LANDSCAPE, TECHNOLOGY [FORSCHUNGSARBEITEN IN DER DFVLR AUF DEM GEBIET DES UMWELTSCHUTZES. TEIL 2: LAERMBEKAEMPFUNG, GEWAESSERSCHUTZ, NATUR UND LANDSCHAFT, UMWELTFREUNDLICHE TECHNIK]
Dieter Paffrath Dec. 1972 84 p refs In GERMAN; ENGLISH summary
(DLR-Mitt-72-15) Avail: NTIS HC $6.25; DFVLR, Porz, West Ger: 21,90 DM

Research work is reported in the fields of abatement of noise from aircraft engines and exhaust jets; formation and propagation of the supersonic boom; measurement of noise emission from aircraft; and noise reduction by constructive means, airport location planning, and layout of flight patterns. Remote sensing instrumentation and techniques were developed for the detection and monitoring of water pollution, and for surveying the change of state at the earth's surface. ESRO

N73-21154# Naval Air Development Center, Warminster, Pa. Crew Systems Dept.
EFFECTS OF FACIAL HAIR IN OXYGEN MASKS Final Report
David G. Naber 29 Dec. 1972 36 p refs
(AD-754075; NADC-72211-CS) Avail: NTIS CSCL 06/11

The objective of this study is to determine whether or not hazards are associated with facial hair on Naval aircrewmen using oxygen breathing equipment. The study showed that undesirable conditions do exist because of facial hair, but there is no evidence of serious injury or fire occuring in aircraft because of hair growth. Indications are that hair segments could become lodged in a valve mechanism causing breathing difficulty and noisy communications. Also, face seal integrity is hard to maintain on facial hair. Each set of test results shows instability of breathing conditions that could be hazardous to the crewman. Therefore, it appears that wearing facial hair should be considered a potential hazard that could affect the safety and efficient operation of the aircraft. Author (GRA)

N73-21090 Joint Publications Research Service, Arlington, Va.
FIRST THE TESTERS FLY
E. Anisimov *In its* Med., Other Probl. of Space Flight 6 Apr. 1973 p 1-6 (For availability see N73-21089 12-04)

N73-21097 Naval Aerospace Medical Research Lab., Pensacola, Fla.
MOTION SICKNESS QUESTIONNAIRE AND FIELD INDEPENDENCE SCORES AS PREDICTORS OF SUCCESS IN NAVAL AVIATION TRAINING
Robert S. Kennedy *In* AGARD Predictability of Motion Sickness in the Selection of Pilots Feb. 1973 5 p refs (For availability see N73-21092 12-04)

N73-21098 School of Aerospace Medicine, Brooks AFB, Tex. Biodynamics Branch.
THE USAFSAM SELECTION, TEST, AND REHABILITATION PROGRAM OF MOTION SICK PILOTS
Patrick J. Dowd *In* AGARD Predictability of Motion Sickness in the Selection of Pilots Feb. 1972 10 p refs (For availability see N73-21092 12-04)

N73-21099 Centre de Medecine Aeronautique, Brussels (Belgium).
THE SELECTION AND SURVEILLANCE OF STUDENT PILOTS WITH MOTION SICKNESS IN THE BELGIAN ARMED FORCES [LA SELECTION ET LA SURVEILLANCE DU POINT DE VUE MAL DE L'AIR DES ELEVES-PILOTES DES FORCES ARMEES BELGES]
S. Tribel *In* AGARD Predictability of Motion Sickness in the Selection of Pilots Feb. 1972 3 p In FRENCH (For availability see N73-21092 12-04)

N73-21100 Institute of Aviation Medicine, Fuerstenfeldbruck (West Germany).
TEST RESULTS ABOUT THE EFFECTIVENESS OF METIXENUM APPLIED AGAINST MOTION SICKNESS
Christian Henning *In* AGARD Predictability of Motion Sickness in the Selection of Pilots Feb. 1973 4 p refs (For availability see N73-21092 12-04)

06 CHEMISTRY

Includes chemical analysis and identification (e.g. spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N73-21155 Massachusetts Univ., Amherst.
THEORY OF DILUTE SOLUTIONS OF HELIUM-THREE IN SUPERFLUID HELIUM-FOUR Ph.D. Thesis
Russell Howard Kulas 1972 187 p
Avail: Univ. Microfilms Order No. 72-19476

The theory of He-3 impurities in He-4 is investigated for the purpose of developing the microscopic theory of the He-3 quasiparticles. A review of the phenomenological theories of the Fermi liquid properties of the He-3 subsystem is presented. This includes the thermodynamic calculation by Bardeen, Baym and Pines of the long wavelength effective interaction between the He quasiparticles. These phenomenological and thermodynamic theories have precipitated and set the context for the development of the microscopic theory. Perturbation theory is used with correlation basis functions (CBF) to calculate the He-3 quasiparticle energy and scattering amplitude to second order, in order to include the effects of the phonon induced interaction. Before that, a diagonal metric procedure is developed which eliminates the ambiguity in the scattering amplitude arising from the non-orthogonality of the CBF. Dissert. Abstr.

N73-21156 National Lending Library for Science and Technology, Boston Spa (England).
THE CHEMICAL MECHANISM DURING THE REACTION SINTERING OF SILICON-SILICON CARBIDE. COMPOSITIONS IN A MEDIUM OF CARBON MONOXIDE AND NITROGEN
E. P. Sadkovsky Jul. 1972 8 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Neorgan. Materialy (Moscow), v. 4, no. 7, 1968 p 1187-1188
(NLL-DRIC-Trans-2768-(3623.66)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

Silicon carbide refractory materials were obtained by a process of reaction sintering in which the gaseous phase contained Si, CO, and N2. These materials are shown to possess valuable properties brought about by the synthesis of highly stable bonds such as beta-SiC, Si3N4, and Si2ON2. In the investigation, samples of a finely ground mixture of silicon carbide and silicon were studied (50:50 mixture) in addition to silicon carbide and silicon separately. A particle size of approximately 2.5 microns was chosen with a porosity of samples equal to about 35% to 37%. Heat treatment was carried out in a plant consisting of a tubular furnace with carborundum heaters, a gas generating plant for producing a mixture of CO + N2 (30:70), and a Type VTI gas analyzer. Author

N73-21157 Institut d'Aeronomie Spatiale de Belgique, Brussels.
MOLECULAR OXYGEN ABSORPTION IN THE SCHUMANN-RUNGE BANDS [ABSORPTION PAR L'OXYGENE MOLECULAIRE DANS LES BANDES DE SCHUMANN-RUNGE]
G. Kockarts 1972 220 p refs In FRENCH; ENGLISH summary 3 Vol.
(Aeronomica-Acta-A-107-1972-V-1) Avail: Issuing Activity

Tables of the molecular oxygen absorption cross sections are given for 180 K from 57030.5 to 49711/cm, for 220 K from 57030.5 to 49111/cm, and for 270 K from 57030.5 to 48871/cm. ESRO

N73-21158 Institut d'Aeronomie Spatiale de Belgique, Brussels.
MOLECULAR OXYGEN ABSORPTION IN THE SCHUMANN-RUNGE BANDS [ABSORPTION PAR L'OXYGENE MOLECULAIRE DANS LES BANDES DE SCHUMANN-RUNGE]
G. Kockarts 1972 195 p In FRENCH; ENGLISH summary 3 Vol.
(Aeronomica-Acta-A-107-1972-V-2) Avail: Issuing Activity

Tables of molecular oxygen absorption cross sections are given for 190 K from 57030.5 to 49711/cm, for 200 K from 57030.5 to 49591/cm, and for 210 K from 57030.5 to 49111/cm. ESRO

N73-21159*# Stanford Univ., Calif. Dept. of Genetics.
THE SIMULTANEOUS QUANTITATION OF TEN AMINO ACIDS IN SOIL EXTRACTS BY MASS FRAGMENTOGRAPHY
W. E. Pereira, Y. Hoyano, W. E. Reynolds, R. E. Summons, and A. M. Duffield [1972] 14 p refs
(Grant NGR 05-020-004)
(NASA-CR-131507) Avail: NTIS HC $3.00 CSCL 07D

A specific and sensitive method for the identification and simultaneous quantitation by mass fragmentography of ten of the amino acids present in soil was developed. The technique uses a computer-driven quadrupole mass spectrometer, and a commercial preparation of deuterated amino acids is used as internal standards for purposes of quantitation. The results obtained are comparable with those from an amino acid analyzer. In the quadrupole mass spectrometer-computer system up to 25 preselected ions may be monitored sequentially. This allows a maximum of 12 different amino acids (one specific ion in each of the undeuterated and deuterated amino acid spectra) to be quantitated. The method is relatively rapid (analysis time of approximately one hour) and is capable of the quantitation of nanogram quantities of amino acids. Author

N73-21160*# Linguistic Systems, Inc., Cambridge, Mass.
HYDROPHOBIC IMINOXYL RADICALS AS UNCOUPLERS OF PHOTOPHOSPHORYLATION IN CHLOROPLASTS
A. I. Tsapin and K. N. Timofeyev Washington NASA Mar. 1973 5 p refs Transl. into ENGLISH from Biofizika (Moscow), v. 17, 1972 p 916-917
(Contract NASw-2482)
(NASA-TT-F-14819) Avail: NTIS HC $3.00 CSCL 07C

It is shown that the esters of 2,2,l,6-tetramethyl-4-oxypyperidine-1-oxyl and higher fatty acids are efficient uncouplers of photophosphorylation in chloroplasts under concentrations about .000001 M. The rate of the Hill reaction is independent of their pressure. Author

N73-21161# Aeronautical Research Inst. of Sweden, Stockholm.
MEASUREMENT OF EQUATION OF STATE VARIABLES OF AIR Final Report
G. Hovstadius 1973 44 p refs
(FFA-au-765) Avail: NTIS HC $4.25

A free piston shock tube driver was developed using a two stage compression technique in which the piston passes through an intermediate diaphragm. The system was used to produce strong shock waves in air. Measurements of the relation between shock speed and air pressure increase, initially at a pressure of one atmosphere, was made in the Mach number region 8-11. It was possible to measure the pressure increase with an accuracy of 3.5% within a few microseconds after the passage of the shock. State variables of air were calculated using the conservation laws over a normal shock. It is concluded that in order to obtain a significant improvement in the results a direct measurement of the density should be made. Use of a square cross-section would improve the accuracy of the technique used, and also facilitate direct measurements of the density. Author

N73-21162*# Kanner (Leo) Associates, Redwood City, Calif.
FORMATION OF HYDROCYANIC ACID FROM MIXTURES OF AMMONIA, METHANE AND A NOBLE GAS OR HYDROGEN THROUGH UHF WAVES
A. Topouzkhanian, J. Dincan, and J. Janin Washington NASA Jan. 1973 22 p refs Transl. into ENGLISH from J. Chim. Phys. Physiochim. Biol. (Paris), v. 66, 1969 p 1299-1306
(Contract NASw-2481)
(NASA-TT-F-14678) Avail: NTIS HC $3.25 CSCL 07D

The action of UHF waves on mixtures of a noble gas, ammonia, and methane at a pressure of 3mm Hg was investigated. Tests with an open network on mixtures of ammonia, methane, and hydrogen; and closed network using a noble gas were conducted. It is concluded that in the formation of hydrocyanic acid from a mixture of ammonia, methane, and a noble gas subjected to ultrahigh frequency waves, the noble gas behaves like an inert diluent. F.O.S.

N73-21163# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Radiochemie.
THERMODYNAMIC INVESTIGATION OF THE SOLUBILITY OF OXYGEN IN TERNARY METAL URANIUM OXIDE WITH A SOLID STATE GALVANIC CELL
E. Stadlbauer Jul. 1972 71 p refs In GERMAN
(KFK-1649) Avail: AEC Depository Libraries

In the selected regions La: (La + U) = 0.05 and O: (La + U) = 2.00 of the ternary system lanthanum-uranium-oxygen emf measurements on solid state galvanic cells, coulometric titrations, and X-ray diffraction techniques were used to obtain phase boundaries and thermodynamic data in the temperature range from 600 to 1000 C. On the basis of the experimental molar solution-entropy of oxygen, a statistical method is given for estimating the fluorite phase of nonstoichiometric metal-uranium-oxygen systems and the molar vibration-entropy of oxygen in the crystal lattice. Author (NSA)

N73-21164# IBM Watson Research Center, Yorktown Heights, N.Y.
SYNTHESIS OF RARE EARTH COMPOUNDS AND STUDY OF THEIR MAGNETIC OPTICAL AND SEMICONDUCTING PROPERTIES Semiannual Technical Report, 30 Jun. - 31 Dec. 1972
F. Hotzberg, L. J. Tao, T. Penney, M. W. Shafer, and S. VonMolnar Jan. 1973 58 p refs
(Contract DAAH01-70-C-1313; ARPA Order 1588; IBM Proj. 2567)
(AD-755925) Avail: NTIS CSCL 20/12

The authors describe transport measurements on the magnetic semiconductor Gd(3-x)v(x)S4. Some of the ideas relating to electrons localized by coulombic disorder to include potential fluctuations of magnetic origin are discussed. Also discussed are the effects on magnetic exchange of conduction electrons donated by nonmagnetic La(---) ions to the Van Vleck ion Sm(--) in SmS. In spite of the fact that Sm(--) has a non-magnetic ground state it has a sizeable susceptibility since its magnetic properties are determined by higher lying multiplet states. The principles of the susceptibility measurement are described as well as a technique for accounting for paramagnetic impurity contributions to chi sub M. The final section is concerned with a study of layer type transition metal dichalcogenides. The authors describe the low temperature intercalation of europium in MoS2 and show that ytterbium and strontium can also be intercalated. The magnetic properties of the three intercalated systems are compared. Author (GRA)

N73-21165# Midwest Research Inst., Kansas City, Mo.
EXPLORATORY DEVELOPMENT FOR STUDIES OF THE VAPORIZATION KINETICS AND THERMODYNAMICS OF GRAPHITE USING THE HIGH PRESSURE MASS SPECTROMETER Technical Management Report No. 10, 16 Oct. 1972 - 16 Jan. 1973
Thomas A. Milne, Jacob E. Beachey, and Frank T. Greene 2 Feb. 1973 33 p refs
(Contract F33615-73-C-5008; MRI Proj. 3709-C)
(AD-755853) Avail: NTIS CSCL 07/4

Diagnostic tests of the time response and ion-transmission behavior of the nuclide double aperture ion source have continued, in an attempt to understand the origin of the double-humped neutral time-of-arrival (TOA) curves observed with carbon vapor and several gases. The object was to aid in the understanding of graphite ablation. Two schemes for operating the ion source in a pulsed mode are presented. Both involve pulsing on the electron beam for a period of 20 microseconds, either by pulsing the filament voltage or by pulsing the ion source housing voltage (J(1)). The pulsed ion source results, which are believed to be independent of ion-trapping effects, generally confirm the normal TOA behavior described in earlier reports. GRA

N73-21166# State Univ. of New York, Buffalo. Dept. of Chemistry.
THE INVESTIGATION OF PROPANE OXIDATION USING ELECTROCHEMICAL MASS SPECTROMETRY Semiannual Report, Jan. - Jun. 1972
Joseph K. Comeau and Stanley Bruckenstein Jun. 1972 47 p refs
(Contract DAAK02-71-C-0306; DA Proj. 1T0-61102-A-34A)
(AD-755254; SAR-2) Avail: NTIS CSCL 07/4

Propane oxidation was studied using electrochemical mass spectrometry as part of a research study for the development of a propane air fuel cell. An investigation of the cathodic desorption product distribution as a function of the potential of propane adsorption was carried out. The product distribution was found to be highly dependent on adsorption potential. Using coulometric and desorption data, the degree of oxidation per adsorbed carbon for both cathodically desorbable and noncathodically desorbable species has been calculated. From these data, it has been possible to speculate on the nature of adsorbed intermediates in the propane oxidation reaction. Advances in porous electrode theory and construction are also discussed. Author (GRA)

N73-21167# Rice Univ., Houston, Tex.
THERMODYNAMIC, ELECTROCHEMICAL AND SYNTHETIC STUDIES OF THE GRAPHITE-FLUORINE COMPOUNDS CF AND C4F Final Report
James L. Wood, Antone J. Valerga, Ram B. Badachhape, and John L. Margrave Dec. 1972 38 p refs
(Contract DAAB07-72-C-0105)
(AD-755934; ECOM-0105-F-72) Avail: NTIS CSCL 07/4

Samples of the solid fluorocarbons CF and C4F have been prepared by direct fluorination of pure graphite. Low temperature heat capacity measurements have been made on both of these samples using a hydrogen cryostat calorimeter. For the compound CF(1.09), c(p) has been measured over the temperature range 5 - 310 K. Values of S and G have been calculated over this range of temperature also. It was possible to calculate the theoretical E for an electrochemical cell using the overall reaction CF(1.12)(s) -1.12 Li (s) yielding 1.12 LiF(s) -C(s). The value of the heat of formation at 298 K for CF (0.2369) has been derived from the energy of combustion in fluorine for the sample of C4F. In addition, low temperature (15-57 K) cp data was gathered for this compound. Author (GRA)

N73-21168# Air Force Materials Lab., Wright-Patterson AFB, Ohio.
PYROLYSIS-GAS CHROMATOGRAPHY: A METHOD FOR RAPID IDENTIFICATION OF POLYMERS Summary Report, Mar. - Oct. 1972
Norbert Iglauer Dec. 1972 104 p refs
(AF Proj. 7367)
(AD-755375; AMRL-TR-72-274) Avail: NTIS CSCL 11/9

A pyrolysis gas chromatography method for the rapid identification of organic polymers is described. The method described here makes use of a Chemical Data Systems Pyrochrom which separates the pyrolyzate into a dual flow system equipped with thermal conductivity and flame ionization detectors. This arrangement permits the determination of both the small and large components present under optimum conditions. A linear temperature program is used to resolve the higher boiling components of the pyrolyzate in a reasonable time. The pyrograms obtained not only offer a fingerprint of the polymer, but also enable a detailed qualitative and quantitative analysis of the fragments of the pyrolyzate. The results of studies on some classes of elastomers, thermoplasts and fabrics are reported. The polymer classes investigated include polyolefins, polyesters, polyurethanes, polyethers, polyamides, phenolics, polycarbohydrates, epoxy resins and polycarbonates. Author (GRA)

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N73-21169 Department of Energy, Mines and Resources, Ottawa (Ontario).
THE RADIO TELEMETRY INSTALLATION AT THE YELLOWKNIFE SEISMIC ARRAY Publications of the Earth Physics Branch, Volume 43, No. 9
E. B. Manchee and R. B. Hayman 1972 23 p refs
Copyright. Avail: Issuing Activity

A medium aperture seismic array at Yellowknife in the Northwest Territories of Canada is described. The mission of the entire Yellowknife system is to acquire a continuous record of short period (SP) and long period (LP) seismic ground motion at a number of relatively closely spaced sites, in order that an evaluation may be made of the utility of seismic arrays in monitoring a possible underground nuclear test ban, and in general studies of earth structure. The SP array consists of 19 seismometer vaults on two orthogonal lines, oriented N-S and E-W. The distance between vaults is 2.5 km. Each vault has a vertical SP seismometer, tone generating and modulating equipment.
Author

N73-21170 Stanford Univ., Calif.
ELF PROPAGATION IN THE PLASMASPHERE BASED ON SATELLITE OBSERVATIONS OF DISCRETE AND CONTINUOUS FORMS Ph.D. Thesis
Jose Luiz Rodolpho Muzzio 1972 122 p
Avail: Univ. Microfilms Order No. 72-20266

Analysis of data from ELF and VLF experiment on OGO-4 satellite has revealed new types of ion whistlers and also some new features of low to medium latitude ELF hiss not previously identified. The ion whistlers identified and interpreted are the 1(-) proton whistler, the ion-cutoff whistler, and combinations of both forms. The observations of ELF hiss permitted the identification of a hiss band and its interpretation in terms of propagation effects, using computer ray tracings. The band exhibits the previously observed low frequency cutoff characteristics of downward propagating hiss and also a peculiar upper cutoff in the vicinity of 600 Hz, which is nearly independent of the satellite altitude (approximately 430 to 900 km) and latitude above approximately 15 deg. This hiss band is called band-limited ELF hiss, or simply BLH. Dissert. Abstr.

N73-21171 California Univ., Los Angeles.
EXPERIMENTAL VERIFICATION OF THE OUTPUT SIGNAL-TO-NOISE RATIO AND TIME-OF-ARRIVAL ESTIMATE OF A TAPPED DELAY LINE MATCHED FILTER USING SURFACE ELASTIC WAVES Ph.D. Thesis
Charles Edward Wheatley, III 1972 220 p
Avail: Univ. Microfilms Order No. 72-20484

Determination is made of two important measures of a matched filter realized with surface elastic waves. These measures are output signal-to-noise ratio and signal time-of-arrival. Tradeoffs necessary to define the waveform and the filter are presented for arriving at a length 63 maximal length sequence, biphase modulating a 120 MHz phase locked carrier, at a 5 MHz rate. The associated matched filter is implemented as a tapped delay line on ST quartz. Limiting values of the performance measures are established for the selected signal and matched filter. Three effects are identified as potentially degrading to the matched filter system. These are bandlimiting, unequal tap weighting, and reflections within the delay line structure. The magnitude of the losses caused by these effects is determined and presented in graphical form. Dissert. Abstr.

N73-21172*# Illinois Univ., Urbana. Aeronomy Lab.
PRELIMINARY DESIGN STUDY OF A HIGH RESOLUTION METEOR RADAR Aeronomy Report No. 52
W. Lee and M. A. Geller 1 Mar. 1973 94 p refs
(Grant NGR-14-005-181)
(NASA-CR-131644; UILU-ENG-73-2502) Avail: NTIS HC $6.75 CSCL 17I

A design study for a high-resolution meteor radar system is carried out with the objective of measuring upper atmospheric winds and particularly studying short period atmospheric waves in the 80 to 120 km altitude region. The transmitter that is to be used emits a peak power of 4 Mw. The system is designed to measure the wind velocity and height of a meteor trail very accurately. This is achieved using a specially developed digital reduction procedure to determine wind velocity and range together

with an interferometer for measuring both the azimuth and elevation angles of the region with a long baseline vernier measurement being used to refine the elevation angle measurement. The resultant accuracies are calculated to be + or - 0.9 m/s for the wind, + or - 230 m for the range and + or - 0.12 deg for the elevation angle, giving a height accuracy of + or - 375 m. The prospects for further development of this system are also discussed. Author

N73-21173*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SIMULTANEOUS L-BAND AND VHF IONOSPHERIC FADING EFFECTS AT THE GEOMAGNETIC EQUATOR
W. B. Sessions (Westinghouse Electric Corp., Baltimore) and T. S. Golden Apr. 1972 20 p refs Presented at the Intern. Union of Radio Sci. (URSI) 1972 Spring Meeting, 13-15 Apr. 1972
(NASA-TM-X-65948; X-810-72-227) Avail: NTIS HC $3.00 CSCL 20N

Simultaneous observations of ionospheric fading of 1550 MHz and 136 MHz radio waves from the ATS-5 spacecraft were recorded on the geomagnetic equator at Ancon, Peru. The observations were made during a period around the 1971 spring equinox; they show fades as great as 27 db at 136 MHz, and 6 db at 1550 MHz. The general characteristics of the scintillation signatures at the two frequencies are discussed with emphasis on comparison of the two frequencies with respect to rates and depths of fades. Typical statistical distributions of signal levels are also presented from which time availabilities of the signals relative to the median levels can be derived. Author

N73-21174# National Bureau of Standards, Boulder, Colo. Time and Frequency Div.
FREQUENCY STABILITY SPECIFICATION AND MEASUREMENT: HIGH FREQUENCY AND MICROWAVE SIGNALS
J. H. Shoaf, D. Halford, and A. S. Risley Jan. 1973 70 p refs
(NBS-TN-632) Avail: SOD HC $0.65 as C13.46:632

Concise definitions for specifying frequency stability for measurements in the frequency domain and time domain are given. Standards of terminology and of measurement techniques are recommended. Measurement systems in the high frequency and microwave regions are described in adequate detail for duplication of the systems. Author

N73-21175# Lockheed Missiles and Space Co., Palo Alto, Calif.
CORRELATION PROPERTIES OF A FILTERED PHASE MANIPULATED SIGNAL
V. I. Vinokurov and R. A. Vakker [1972] 16 p Transl. into ENGLISH from the book "Voprosy Obrabotki Slozhnykh Signalov v Korrelatsionnykh Sistemakh" Moscow, Sov. Radio, 1972 p 163-187
Avail: NTIS HC $3.00; National Translations Center, John Crerar Library, Chicago, Ill. 60616

The influence of linear filtration on the correlation properties of phase manipulated signals is estimated. Cases are examined when the carrier frequency is large compared to the width of the energy spectrum of the sequence. Author

N73-21176# Lockheed Missiles and Space Co., Palo Alto, Calif.
CODERS
N. D. Bosyi [1972] 9 p Transl. into ENGLISH from the book "Mnogkanalnye Sistemy Peredachi Informatsii" Kiev, Tekhn., 1971
Avail: NTIS HC $3.00; National Translations Center, John Crerar Library, Chicago, Ill. 60616

Description is given of the shaping of a binary code signal as being brought about by the deflection of an electron beam in a magnetic or electrical rotating field after being reflected from a ring reflecting electrode and then returned to a tube axis. The ring deflecting capacitor which controls the beam path is placed between the reflector electrode and the axis. A coding mask and collector plate are placed at the center of the tube. When the electron beam passes through a hole in the code mask a sequential code signal is formed. The rate of electron beam rotation is determined by the synchronization frequency, and the gate signal is converted into a voltage on the plates of a ring capacitor which controls the beam deflection. Pulses obtained at the output of the coding tubes go to a regenerator in which their parameters are normalized, i.e., identical amplitudes and durations are reconstituted. Author

N73-21177# Sperry Rand Corp., St. Paul, Minn. Defense Systems Div.
ARTS 3 AUGMENTED TRACKING STUDY Final Report
B. Smulowicz (ARCON Corp.), R. Sittler (ARCON Corp.), M. Wold, G. Kelly, B. Birkholz, and L. Cady Washington FAA Jun. 1972 273 p
(Contract DOT-FA70WA-2289; FAA Proj. 19180)
(PX-6392; FAA-RD-73-27) Avail: NTIS HC $15.75

The results obtained during investigation of methods for improving aircraft tracking techniques within the ARTS-III system are presented. This study recognizes the current tracking level of the Basic Radar Beacon Tracking Level (RBTL) system as the starting point for development. At this level, both radar and beacon target reports from a common sensor site are available for tracking. The work described by this report is an investigation of new methods for utilizing these target reports as well as optimizing and refining existing methods. In addition to seeking methods for upgrading the tracking function, considerations for improving system performance through integration of the video processing, target detection, and display functions with tracking are also investigated. Numerous alternatives are considered and results of both those which show potential for improvement as well as those which show definite limitations are included. Author

N73-21178*# Michigan Univ., Ann Arbor. Radiation Lab.
THE ELECTROMAGNETIC RADIATION FROM SIMPLE SOURCES IN THE PRESENCE OF A HOMOGENEOUS DIELECTRIC SPHERE
V. Bradford Mason Washington NASA Mar. 1973 146 p refs
(Grant NGR-23-005-477)
(NASA-CR-2211) Avail: NTIS HC $3.00 CSCL 20N

In this research, the effect of a homogeneous dielectric sphere on the electromagnetic radiation from simple sources is treated as a boundary value problem, and the solution is obtained by the technique of dyadic Green's functions. Exact representations of the electric fields in the various regions due to a source located inside, outside, or on the surface of a dielectric sphere are formulated. Particular attention is given to the effect of sphere size, source location, dielectric constant, and dielectric loss on the radiation patterns and directivity of small spheres (less than 5 wavelengths in diameter) using the Huygens' source excitation. The computed results are found to closely agree with those measured for waveguide-excited plexiglas spheres. Radiation patterns for an extended Huygens' source and for curved electric dipoles located on the sphere's surface are also presented. The resonance phenomenon associated with the dielectric sphere is studied in terms of the modal representation of the radiated fields. It is found that when the sphere is excited at certain frequencies, much of the energy is radiated into the sidelobes. The addition of a moderate amount of dielectric loss, however, quickly attenuates this resonance effect. A computer program which may be used to calculate the directivity and radiation pattern of a Huygens' source located inside or on the surface of a lossy dielectric sphere is listed. Author

N73-21179# Lockheed Missiles and Space Co., Palo Alto, Calif.
SIGNAL/NOISE RATIO IN OPTICAL LOCATION SYSTEMS
V. A. Ovsiannikov and A. M. Romanov [1972] 4 p refs Transl. into ENGLISH from Opt.-Mekh. Prom. (Leningrad), no. 1, 1973 p 11-14
Avail: NTIS HC $3.00; National Translations Center, John Crerar Library, Chicago, Ill. 60616

Expressions are obtained for the generalized signal to noise ratio at the output of system for the optimal detection of optical signals received in a background of white, hyperbolic, and mixed receiver noises. The optimal filter is compared with a filter realized on the basis of passive integro-differentiating loops. Author

N73-21180# Lockheed Missiles and Space Co., Palo Alto, Calif.
INFLUENCE OF LINEAR CHANNELS ON THE CORRELATION PROCESSING OF NOISE SIGNALS, CHAPTER 6
V. I. Vinokurov and R. A. Vakker [1972] 14 p Transl. into

ENGLISH from the book "Voprosy Obrabotki Slozhnykh Signalov v Korrelatsionnykh Sistemakh" Sovetskoe Radio, Moscow, 1972 p 140-163
Avail: NTIS HC $3.00; National Translations Center, John Crerar Library, Chicago, Ill. 60616

An attempt is made to examine the influence of linear converters on the characteristics of a correlation system. After signal presence is established, signal delay time is measured. The influence of linear filters on the detectability of measuring delay on the correlation system is discussed. Author

N73-21181# Lockheed Missiles and Space Co., Palo Alto, Calif.
CORRELATION PROPERTIES OF SIGNALS, CHAPTER 1
V. I. Vinokurov and R. A. Vakker [1972] 21 p Transl. into ENGLISH from the book "Voprosy Obrabotki Slozhnykh Signalov v Korreliatsionnykh Sistemakh" Sovetskoe Radio, Moscow, 1972 p 7-35
Avail: NTIS HC $3.25; National Translations Center, John Crerar Library, Chicago, Ill. 60616

The application of statistical methods of analysis for determining the correlation properties of signals is discussed. The mathematical procedures for analyzing random phenomena are analyzed. Definitions of the correlation function, stationary processes, auto-correlation functions, ergodic random processes, and nonlinear transformations are presented. The application of these mathematical relationships to radio signal reception and demodulation is described. Author

N73-21182# National Aviation Facilities Experimental Center, Atlantic City, N.J.
TESTS OF THE VEGA AIRCRAFT RADAR ENHANCING SYSTEM (VARES) Final Report, Nov. 1971 - Oct. 1972
Dominick L. Offi Apr. 1973 43 p
(FAA Proj. 022-241-030)
(FAA-RD-73-38; FAA-NA-73-14) Avail: NTIS HC $4.25

A cross-band radar/beacon system, designed to operate within the constraints of the airport surveillance radar/air traffic control interrogator (ASR/ATCBI) environment was evaluated. The equipment, known as the Vega Aircraft Radar Enhancing System (VARES) was tested to determine technical as well as operational characteristics. The VARES equipment as originally designed was not electrically nor mechanically compatible with the ASR/ATCBI system, nor with the aircraft available. With proper modifications, the system provided an increased radar detection capability. In addition, limited tests indicated evidence of possible interference with the ATC Beacon System. Author

N73-21183*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ANALYSIS OF A DUAL-REFLECTOR ANTENNA SYSTEM USING PHYSICAL OPTICS AND DIGITAL COMPUTERS
Richard F. Schmidt Oct. 1972 42 p refs
(NASA-TM-X-66223; X-811-72-392) Avail: NTIS HC $4.25 CSCL 17B

The application of physical-optics diffraction theory to a deployable dual-reflector geometry is discussed. The methods employed are not restricted to the Conical-Gregorian antenna, but apply in a general way to dual and even multiple reflector systems. Complex vector wave methods are used in the Fresnel and Fraunhofer regions of the reflectors. Field amplitude, phase, polarization data, and time average Poynting vectors are obtained via an IBM 360/91 digital computer. Focal region characteristics are plotted with the aid of a CalComp plotter. Comparison between the GSFC Huygens wavelet approach, JPL measurements, and JPL computer results based on the near field spherical wave expansion method are made wherever possible. Author

N73-21184# Joint Publications Research Service, Arlington, Va.
ELECTROMAGNETIC RADIATION SAFETY
V. A. Krylov and T. V. Yuchenkova 18 Apr. 1973 194 p refs Transl. into ENGLISH of the book "Zashchita ot Elektromagnitnykh Izlucheniy" Moscow, Izd-vo Sovetskoye radio, 1972
(JPRS-58783) Avail: NTIS HC $11.75

Theoretical data on radiation, its interaction with the environment, the effect of radiation on the body and measures for protecting man are discussed. Data on treatment, preventive measures to reduce the negative effect of emissions, and discussion of the physiological and economic aspects of electromagnetic radiation safety are presented. Author

N73-21185# Defence Research Information Centre, Orpington (England).
NEW INSTRUMENTS AND METHODS OF MEASUREMENT. ELECTRONIC METHODS OF GENERATING SUPERNARROW PULSES
A. S. Koporskii et al Dec. 1972 18 p refs Transl. into ENGLISH from Usp. Fiz. Nauk, (Moscow), v. 63, no. 4, 1957 p 801-812
(DRIC-Trans-2934; BR-30301) Avail: NTIS HC $3.00

The principle of the operation of electronic pulse generators is reviewed. Problems such as diffusion of electron packets and excitation of the output device, arising in the generation of pulses by electronic methods, are presented. Existing methods of pulse generation and various generator designs are described, including the klystron type, the beam deflection, and the magnetic braking pulse generators. The chief advantages of electronic generators are simplicity, stability in operation, and the ability to produce very narrow pulses over a wide range of repetition frequencies. However, existing generators are mostly low-power and have a limited range of application. ESRO

N73-21186# Fernmeldetechnisches Zentralamt, Darmstadt (West Germany).
ACTIVITIES OF THE RESEARCH INSTITUTE Annual Report, 1972 [JAHRESBERICHT 1972]
1972 269 p refs In GERMAN
Avail: NTIS HC $15.50

Activities in the field of telecommunication research are reported. The topics mentioned are data transmission, radio links, echo attenuation on satellite links, vocoders, recognition of speech in heavy noise, TV transmission, redundancy reduction for PCM TV signals on satellite links, digital transmission methods, FM wave propagation in the atmosphere, solid state electronics, and microwave technology. ESRO

N73-21187# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Inst. fuer Flugfunk und Mikrowellen.
PHASE RESPONSE CHARACTERISTICS OF A PLATINOTRON [PHASENSCHWANKUNGEN EINES PLATINOTRONS]
Helmut Kietzmann 1973 44 p refs In GERMAN; ENGLISH summary
(Contract T-521-K-203)
(DLR-MITT-73-03) Avail: NTIS HC $4.25

A double probe method was used to determine the statistical pulse-to-pulse phase variations of a platinotron. The platinotron is a high frequency amplifier tube based on the crossed field amplifier principle, which can be operated either as a self-exciting oscillator or as a power amplifier. For its application to pulse radar and phase-controlled antenna arrays, it is important to know in advance the small phase variations for high output power. The results of the double probe measurement give a quantitative statement on the frequency distributions of the statistical phase variations. ESRO

N73-21188# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugfuehrung.
OPTIMIZATION OF THE NOISE IMMUNITY OF TRANSMISSION CHANNELS FOR ANALOG SIGNALS BY MEANS OF PRE-EMPHASIS Ph.D. Thesis - Tech. Univ. Brunswick [OPTIMIERUNG DER RAUSCHBELASTBARKEIT VON UEBERTRAGUNGSKANAELEN FUER ANALOGE SIGNALE DURCH PREEMPHASIS]
Alfred Becker 1972 89 p refs In GERMAN; ENGLISH summary
(DLR-FB-73-09) Avail: NTIS HC $6.50; DFVLR, Porz, West Ger: 17 DM

The preemphasis of a signal by means of a linear filter is a powerful method of improving the immunity of the signal quality against the noise of the subsequent transmission channel. On the assumption of known signal-and-noise power spectra the frequency response of the optimum preemphasis filter is derived. The quality measure is defined in terms of powers.

Plots of the optimized values of signal power, channel cutoff-frequency and gain are given. The assumed signal model consists of Gaussian distribution and approximated Butterworth spectrum in connection with an amplitude- and frequency-limited AM or FM channel. The calculated gain is in the order of 8 db to 45 db. Author (ESRO)

N73-21189# Illinois Univ., Urbana. Antenna Lab.
ANALYTIC RADAR TARGET MODELING Final Report, 5 Nov. 1971 - 5 Nov. 1972
R. Mittra, S. W. Lee, and C. A. Chuang Dec. 1972 96 p refs
(Contract DAAH01-72-C-0329)
(AD-755854; UIAL-72-14; UILU-ENG-72-2558) Avail: NTIS CSCL 17/9

The report studies the electromagnetic radar scattering parameters for a complex airborne target at high frequencies. The components of the target are modeled by simple geometrical shapes including ellipsoids, elliptical plates, ogives. Semi-individual components are derived in terms of simple analytical functions. These are subsequently combined, in a consistent manner that takes into consideration the geometrical phase delay and shadowing effect, to yield the total scattered field from the target. Extensive numerical results are presented for the T-33 aircraft and the BQM-34A drone. A comparison of our theoretical computations with experimental data measured by a nanosecond short-pulsed radar reveals reasonably good agreement.
Author (GRA)

N73-21190# California Univ., Los Angeles. School of Engineering and Applied Science.
AN OPTIMAL CONTROL APPROACH TO DESIGNING CONSTANT GAIN FILTERS
Kitchener Clark Wilson Sep. 1972 30 p refs
(Contract F04701-72-C-0273; Grant AF-AFOSR-2166-72; AF Proj. 9769)
(AD-755798; UCLA-ENG-7277; AFOSR-73-0229TR) Avail: NTIS CSCL 17/9

The paper applies optimal control theory to designing constant gain filters which minimize a weighted average of the filtered variances. Uni-axial second order motion is studied in detail, and an example is given which indicates that a constant gain filter may be designed with performance comparable to a Kalman filter. An appendix is included which shows how the approach may be extended to higher order systems. Author (GRA)

N73-21191# Federal Electric Corp., Vandenberg AFB, Calif.
COMMUNICATIONS SYSTEMS HANDBOOK
Space and Missile Test Center Mar. 1972 147 p refs
(Contract F04701-72-C-0102)
(AD-755917; SAMSO-TR-73-76; SAMTEC-TR-72-2) Avail: NTIS CSCL 17/2

The handbook describes SAMTEC communications resources used to satisfy all range and range use needs for the transmission of information. Transmission systems consist of SAMTEC, SAC, Defense Communications Agency (DCA), and commercial communications facilities. The intelligence is transmitted as video, data, teletype, and voice communications. Various transmission media include: microwave, high frequency (HF), cable, submarine cable, and cable multiplex carriers. The configuration of the range communications system is in a continuing state of evolution and progress. Therefore, this handbook should be used as a guide rather than to determine specific information.
Author (GRA)

N73-21192# Rhode Island Univ., Kingston. Dept. of Electrical Engineering.
PROPAGATION AND RESONANCE PARAMETERS OF THE EARTH-IONOSPHERE CAVITY - SPHERICAL VERSUS PLANAR STRATIFICATION OF THE IONOSPHERE, PART 2 Final Report, 16 Nov. 1969 - 15 Nov. 1972
Anh Tran and Charles Polk 15 Nov. 1972 64 p refs
(Contract F19628-70-C-0090; AF Proj. 5631)
(AD-755391; AFCRL-72-0682; Rept-4255/2) Avail: NTIS CSCL 17/2

In treating ELF wave propagation in the Earth-Ionosphere cavity, the flat earth approximation may be derived from the exact equations for the spherical cavity by introducing a second order or Debye approximation for the spherical Hankel functions. In the frequency range 3 to 30 Hz, however, the assumed conditions for the Debye approximation are not satisfied. For this reason an exact evaluation of the spherical Hankel functions is used to study the effects of the flat earth approximation on various propagation and resonance parameters. Author (GRA)

N73-21193# Syracuse Univ., N.Y. Dept. of Electrical and Computer Engineering.
SYNTHESIS OF LOADED N-PORT SCATTERS
Roger F. Harrington and Joseph R. Mautz Hanscomb Field, Mass. AFCRL Oct. 1972 116 p refs
(Contract F19628-68-C-0180; AF Proj. 5635)
(AD-755914; SR-17; AFCRL-72-0665) Avail: NTIS CSCL 17/9

The report gives methods for designing reactively loaded N-port scatterers to have desired scattering pattern characteristics. A method for obtaining a least-squares approximation to a desired magnitude radiation pattern, with the restriction that port currents are real, is developed. A procedure for obtaining maximum gain, with the restriction that the port currents are real, is also described. Conducting bodies can be reactively loaded to make any real port current the dominant port mode of that body. If the body is electrically small or of intermediate size, and if a sufficient number of ports are chosen, then the scattered field pattern is approximately the same as the synthesized pattern. A number of numerical examples are given for a body consisting of a wire triangle with two cross wires, on which four ports are defined. Computer programs with sample input - output data are given for each procedure discussed. Author (GRA)

N73-21759* Stanford Univ., Calif.
BISTATIC-RADAR INVESTIGATION
H. T. Howard and G. L. Tyler *In* NASA. Lyndon B. Johnson Space Center Apollo 16 Prelim. Sci. Rept. 1972 13 p (For availability see N73-21729 12-30)
CSCL 17I

N73-21788* Massachusetts Inst. of Tech., Cambridge. Haystack Observatory.
CALIBRATION OF RADAR DATA FROM APOLLO 16 RESULTS, PART X
S. H. Zisk and H. J. Moore (Geol. Surv.) *In* NASA. Lyndon B. Johnson Space Center Apollo 16 Prelim. Sci. Rept. 1972 3 p ref (For availability see N73-21729 12-30)
CSCL 17I

08 COMPUTERS

Includes computer operation and programming; and data processing. For applications, see specific categories. For related information see also: 19 Mathematics.

N73-21194*# Computer Sciences Corp., Huntsville, Ala. Aerospace Systems Center.
SPACE ULTRARELIABLE MODULAR COMPUTER (SUMC) INSTRUCTION SIMULATOR Final Report
R. T. Curran Nov. 1972 234 p refs
(Contract NAS8-26698)
Avail: NTIS HC $13.75 CSCL 09B

The design principles, description, functional operation, and recommended expansion and enhancements are presented for the Space Ultrareliable Modular Computer interpretive simulator. Included as appendices are the user's manual, program module descriptions, target instruction descriptions, simulator source program listing, and a sample program printout. In discussing the design and operation of the simulator, the key problems involving host computer independence and target computer architectural scope are brought into focus. Author

N73-21195*# Radio Corp. of America, Camden, N.J. Advanced Technology Labs.
SUMC-DV HARDWARE MANUAL
A. Feller Nov. 1972 131 p
(Contract NAS12-2233)
(NASA-CR-124205) Avail: NTIS HC $8.75 CSCL 09B

The assembly, the physical and electrical characteristics, and

the basic electrical tests of the Space Ultrareliable Modular Computer Demonstration Vehicle (SUMC-DV), are described. The descriptions include: (1) the packaging concepts, physical assembly, design and fabrication using design automation techniques of 10 different types of custom CMOS LSI arrays; (2) the fabrication and testing of the various components including the LSI arrays; (3) the hierarchy of the memory complement and the clock generation and distribution system; (4) system testing techniques; and (5) the procedure employed in the electrical checkout of the system. Author

N73-21196# RAND Corp., Santa Monica, Calif.
NOTES ON VALIDATING/VERIFYING COMPUTER SIMULATION MODELS
Morton B. Berman Aug. 1972 13 p refs Presented at the SHARE 39 Conf., Toronto, 9 Aug. 1972
(P-4891) Avail: NTIS HC $3.00

A survey is presented of some of the existing literature on validation and verification of computer simulation models. They summarize ideas and thoughts that illuminate approaches to gaining confidence in the insights provided by computer simulation models. Author

N73-21197# National Bureau of Standards, Washington, D.C. Systems Development Div.
A SET OF DEBUGGING AND MONITORING FACILITIES TO IMPROVE THE DIAGNOSTIC CAPABILITIES OF A COMPILER
Elizabeth Fong Mar. 1973 24 p refs
(NBS-TN-763) Avail: SOD HC $0.50 domestic postpaid or $0.35 GPO Bookstore

Increasing concern with the quality of computer software today makes it important to evaluate critically the debugging facilities available in high level languages. A collection of program debugging and monitoring facilities to improve the diagnostic capabilities of a compiler is presented. A distinction is made between debugging and monitoring facilities performed at compile time, at link/load time and at execution time. These facilities are described in terms of this breakdown with a conscious attempt to move the detection of errors from execution time to compile or link/load time, and to collect information when the information is available during the compilation process. Author

N73-21198*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ANALYSIS OF THE COMPUTED TORQUE DRIVE METHOD AND COMPARISON WITH CONVENTIONAL POSITION SERVO FOR A COMPUTER-CONTROLLED MANIPULATOR
B. R. Markiewicz 15 Mar. 1973 58 p refs
(Contract NAS7-100)
(NASA-CR-131521; JPL-TM-33-601) Avail: NTIS HC $5.00 CSCL 09B

A manipulator and its control system (modeled after a Stanford design) is being developed as part of an artificial intelligence project. This development includes an analytical study of the control system software. A comparison is presented of the computed torque method and the conventional position servo. No conclusion is made as to the preference of one system over the other, as it is dependent upon the application and the results of a sampled data analysis. Author

N73-21199*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
CONTINUOUS FOURIER TRANSFORM METHOD AND APPARATUS Patent Application
Robert M. Munoz, inventor (to NASA) Filed 18 Apr. 1973 24 p
(NASA-Case-ARC-10466-1; US-Patent-Appl-SN-352382) Avail: NTIS HC $3.25 CSCL 09B

An input analog signal to be frequency analyzed is separated into N number of simultaneous analog signal components, each identical to the original but delayed relative to the original by a successively larger time delay. The separated and delayed analog components are combined in a suitable number of adders and attenuators in accordance with at least one component product of the continuous Fourier transform and analog signal matrices to separate the analog input signal into at least one of its continuous analog frequency components of bandwidth 1/N times the bandwidth of the original input signal. Given the separated frequency components, the original analog input signal can be reconstituted by combining the separate analog frequency components in accordance with the component products of the continuous Fourier transform and analog frequency component matrices. The continuous Fourier transformation is useful for spectrum analysis, filtering, transfer function synthesis, and communications. NASA

N73-21200*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
PROPOSAL FOR HIERARCHICAL DESCRIPTION OF SOFTWARE SYSTEMS
H. Thauboth Washington Mar. 1973 138 p refs
(NASA-TN-D-7200) Avail: NTIS HC $3.00 CSCL 09B

The programming of digital computers has developed into a new dimension full of difficulties, because the hardware of computers has become so powerful that more complex applications are entrusted to computers. The costs of software development, verification, and maintenance are outpacing those of the hardware and the trend is toward futher increase of sophistication of application of computers and consequently of sophistication of software. To obtain better visibility into software systems and to improve the structure of software systems for better tests, verification, and maintenance, a clear, but rigorous description and documentation of software is needed. The purpose of the report is to extend the present methods in order to obtain a documentation that better reflects the interplay between the various components and functions of a software system at different levels of detail without losing the precision in expression. This is done by the use of block diagrams, sequence diagrams, and cross-reference charts. In the appendices, examples from an actual large sofware system, i.e. the Marshall System for Aerospace Systems Simulation (MARSYAS), are presented. The proposed documentation structure is compatible to automation of updating significant portions of the documentation for better software change control. Author

N73-21201# Joint Publications Research Service, Arlington, Va.
PRINCIPLES OF MULTIPROGRAMMING FOR SPECIAL PURPOSE COMPUTERS
S. D. Pashkeyev 27 Mar. 1973 14 p Transl. into ENGLISH from the book "Osnovy Multiprogrammirovaniya dlya Spectsializirovannykh Vychislitelnykh Sistem" Moscow, Sov. Radio, 29 Feb. 1972 p 2-11
(JPRS-58571) Avail: NTIS HC $3.00

The basic problems of multiprogramming are discussed for multicomputer homogeneous specialized systems: analysis of multiprogramming situations, multiprogrammed conversion of algorithms, multiprogrammed planning, multiprogrammed centralized control and evaluation of the effectiveness of multiprogramming. Author

N73-21202# Joint Publications Research Service, Arlington, Va.
BESM-4 AND SDS-1604A COMPUTER VIDEODISPLAY AND ITS APPLICATION IN PROCESSING SPARK AND BUBBLE-CHAMBER PHOTOGRAPHS
A. I. Yefimova, G. I. Zabiyakin, A. A. Karlov, A. P. Kretov, I. N. Kukhtina, F. V. Levchanovskiy, V. I. Prikhodko, V. R. Trubnikov, and E. V. Sharapova 11 Apr. 1973 13 p. refs Transl. into ENGLISH from Pribory i Tekhn. Eksperim. (Moscow), no. 4, 1971 p 91-96
(JPRS-58713) Avail: NTIS HC $3.00

The technical feasibility of a videodisplay based on the cathode ray tube, light pen and mating of the videodisplay with the computer is examined. Utilization and software of the BESM-4 and SDS-1604A computer videodisplay in application to processing spark and bubble-chamber photographs is considered. Author

N73-21203*# Maryland Univ., College Park. Computer Science Center.
SIMPL-X, A LANGUAGE FOR WRITING STRUCTURED PROGRAMS
Victor R. Basili Jan. 1973 51 p refs
(Grant NGL-21-002-008; Contract N00014-67-A-0239-0021; NR Proj. 044-431)

(NASA-CR-131473; AD-755703; TR-223) Avail: NTIS HC $4.75 CSCL 09/2

The report contains a description of the programming language, SIMPL-X, which is the base language for a family of programming languages that will be extensions to SIMPL-X and whose compilers will be written in SIMPL-X and its extensions. It is a transportable compiler-writing, systems language which was developed to provide a basis for the redefinition of the graph algorithmic language GRAAL. SIMPL-X is a procedure-oriented, non-block structured language with an extensive set of operators, including arithmetic, relational, logical, bit manipulation, shift, indirect reference, address reference, and part-word operators. It is designed for writing GRAAL programs that conform to the standards of structured programming and modular design and for efficiently expressing and implementing algorithms written in it. In addition, it appears to be a good language for modeling and certifying the correctness and equivalance of programs. Implementation for a Univac 1108 computer is described. GRA

N73-21204*# Maryland Univ., College Park. Computer Science Center.

GRAPH STRUCTURE ALGORITHMS IN FGRAAL

Charles K. Mesztenyi and Werner C Rheinboldt Jan. 1973 100 p refs

(Grant NGL-21-002-008; Contract N00014-67-A-0239-0021; NR Proj. 044-431)

(NASA-CR-131474; AD-755704; TR-225) Avail: NTIS HC $7.00 CSCL 09/2

FGRAAL is a FORTRAN-based graph algorithmic compiler language designed for use in the solution of applied graph problems. This report describes a number of UNIVAC 1108 routines which analyze the topological structure of directed and undirected graphs, including induced subgraphs, spanning trees, connected and strong components, fundamental cycles and co-cycles, and blocks. In addition, several utility procedures and input/output routines are described, as well as a random graph generator. GRA

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N73-21205 Syracuse Univ., N.Y.

ANALYSIS AND DESIGN OF CIRCULAR ANTENNA ARRAYS BY MATRIX METHODS Ph.D. Thesis

Donald Hugh Sinnott 1972 161 p

Avail: Univ. Microfilms Order No. 72-20368

The analysis and design of a general class of antenna arrays is presented. These consist of a number of identical parallel dipoles, equally spaced around and perpendicular to a circle. The analysis is performed using the techniques of the method of moments. The simple geometry of the circular array leads to important simplifications and economies in the formulation and the ensuing solution for the antenna currents as a function of the driving voltages. Versatile computer programs are listed for efficient analysis of circular arrays and some examples are given. A set of computer programs is included also for the solution of important classes of pattern synthesis problems involving circular arrays. Dissert. Abstr.

N73-21206 California Univ., Los Angeles.

COUPLED MODES ON DIELECTRIC IMAGE WAVEGUIDE Ph.D. Thesis

Richard Daniel Posner 1972 212 p

Avail: Univ. Microfilms Order No. 72-20467

A dielectric image waveguide is described which is a cylinder of dielectric material upon a highly conducting ground plane. The solution to Maxwell's equations for these structures show that electromagnetic energy can propagate as modes guided by the structure and as waves that radiate. When two such guides are in close proximity some of the power in the guided modes couples between structures. This problem is explored in detail. It is shown that in the case of loose coupling the effect of the coupling can be characterized by coupling coefficients. A method is developed to obtain these coefficients between any dielectric image waveguide in terms of the modes on each structure. It is shown further that the solution to the dielectric image waveguide problem is a subset of solutions for a dielectric waveguide consisting of the dielectric image guide and its image with respect to the ground plane. Dissert. Abstr.

N73-21207 Oregon State Univ., Corvallis.

A MOS-TRANSISTOR WITH A SUBMICRON, AND GRADED CHANNEL Ph.D. Thesis

Pen Chao Chou 1972 231 p

Avail: Univ. Microfilms Order No. 72-18851

The theoretical aspects and fabrication techniques of a new surface field-effect transistor were investigated. The new MOS-transistor uses a three-layer structure similar to those found in bipolar transistors. The MOS structure introduces an impurity gradient in the channel region of the transistor and also makes it possible to reduce the channel length to the order of 0.5 microns as a lower limit. The impurity gradient in the channel region and the impurity profile of source, channel and drain regions are analyzed to establish a device model which characterizes the transistor with emphasis on its high frequency capability. A basic fabrication process was developed in the project, which yielded successful devices capable of operating at a cutoff frequency in excess of one gigahertz and a drain supply of 100 volts. Improvements in operating frequency and other device parameters are still possible by optimizing the design of the experimental device. Dissert. Abstr.

N73-21208 Oregon State Univ., Corvallis.

APPLICATION OF PIEZOELECTRIC QUARTZ CRYSTAL AS PARTITION DETECTOR; DEVELOPMENT OF A DIGITAL TRANSDUCER Ph.D. Thesis

Morteza Janghorbani 1972 182 p

Avail: Univ. Microfilms Order No. 72-20751

AT-cut piezoelectric quartz crystals coated with low vapor pressure materials are evaluated as digital transducers in completely digital detection systems for monitoring gas streams. Mathematical relations describing the detectors are developed and tested. Specific application is made to monitoring gaseous sulfur compounds commonly found in stack effluents of pulp mills. It is shown that detectors formed by coating such crystals with a liquid capable of dissolving the gas of interest exhibit reversible characteristics with subsecond response times. Furthermore, if the sorbate-sorbent interactions are physical the detector exhibits linear response to varying concentrations of sorbate over the entire working range. Curvilinear plots are obtained if there are stronger interactions between the sorbate-sorbent pair. In the extreme case where there is chemical reaction between the two, the detector becomes irreversible, exhibits slow response characteristics, becomes integrating in nature, and can be used as specific detector with very high sensitivity. Dissert. Abstr.

N73-21209*# Varian Associates, Palo Alto, Calif. Tube Div.

DESIGN, CONSTRUCTION AND EVALUATION OF A 12.2 GHz, 4.0 kW-CW COUPLED-CAVITY TRAVELING WAVE TUBE Final Report

W. R. Ayers and W. A. Harman Mar. 1973 180 p refs

(Contract NAS3-13728)

(NASA-CR-120920) Avail: NTIS HC $11.00 CSCL 09A

An analytical and experimental program to study design techniques and to utilize these techniques to optimize the performance of an X-band 4 kW, CW traveling wave tube ultimately intended for satellite-borne television broadcast transmitters is described. The design is based on the coupled-cavity slow-wave circuit with velocity resynchronization to maximize the conversion efficiency. The design incorporates a collector which is demountable from the tube. This was done to facilitate multistage depressed collector experiments employing a NASA designed axisymmetric, electrostatic collector for linear beam microwave tubes after shipment of the tubes to NASA. Author

N73-21210# Danish Research Center for Applied Electronics, Hoersholm.

LOGARITHMIC DETECTOR [LOGARITMISK DETEKTOR]
E. Bech and S. T. Olesen Feb. 1973 33 p refs In DANISH
(ECR-32) Avail: NTIS HC $3.75

Hybrid thick film technology is used in the computerized design of a transistorized logarithmic detector for 500 MHz satellite tracking. The device incorporates six linear amplifiers with epitactic n-p-n silicon planar ultrahigh frequency transistors suitable for high frequency broadband amplification. Transl. by G.G.

N73-21211# Danish Research Center for Applied Electronics, Hoersholm.
MONOLITHIC CHIP CAPACITORS: AN EVALUATION OF CERAMIC CHIP CAPACITORS FOR THICK AND THIN FILM HYBRID CIRCUITS
S. T. Olesen Oct. 1972 36 p
(ECR-28) Avail: NTIS HC $4.00

Sixteen different types of monolithic chip capacitors are described. Both multilayer and disk types are represented, as well as both NPO and high K types. The choice of tests performed, together with the special failure index system, are used to give a good all round impression of the quality level of the different types. Author

N73-21212# Hittman Associates, Inc., Columbia, Md.
Ni/ZrO2 HIGH TEMPERATURE THERMAL SWITCH PROGRAM Final Report, Jul. - Dec. 1971
Jul. 1972 36 p ref
(Contract AT(29-2)-2797)
(HIT-527) Avail: NTIS

A high temperature metal thermal switch program is described which is directed to the design, development, and testing of thermal switch composite materials for reentry protection of radioisotope thermoelectric generator (RTG) heat sources. Activities are directed toward further development of the electroless nickel deposition-impregnation process for the fabrication nickel/zirconia composite sleeves with a uniform nickel impregnation throughout the sleeve. A process specification was prepared for the fabrication of nickel/zirconia composite sleeves. Thermal conductivity data on nickel/zirconia composites was determined by the cut-bar comparative test. The conductivity at 500 F was determined for four nickel loading. The thermal conductivity measurements show good agreement with data reported in the previous phase. Mechanical property measurements show increased compressive and transverse rupture strengths over composites fabricated and tested in the previous phase. Author (NSA)

N73-21213# Stanford Linear Accelerator Center, Calif.
POWER LOSSES IN RF SUPERCONDUCTING CAVITIES
Mario Rabinowitz Sep. 1972 7 p refs Presented at the Electron and Atomic Phys. Div. Meeting, Seattle, 23 Nov. 1970 Sponsored by AEC
(SLAC-PUB-963; CONF-701111-4) Avail: NTIS

Power losses in microwave superconducting cavities are not well understood at very low temperatures and/or at very high field levels. Established theories of superconducting surface resistance do not work in these ranges. It is proposed that the discrepancy lies in the presence of nonsuperconducting power loss mechanisms. Various mechanisms are considered, such as dielectric loss due to surface contamination by oxides and adsorbed gas; field emission; normal regions; fluxoids; etc. Cavity Q (approximately 10 to the 11th power) is extremely sensitive to impurities and lattice defects on and near the surface. An oscillating fluxoid is most likely responsible for critical power loss at high field levels, and small stationary normal regions for residual power loss at low temperature. Author (NSA)

N73-21214# Bendix Corp., Kansas City, Mo.
ELECTRICAL TERMINATIONS: WELDED, BRAZED, AND BONDED, FY 72-2 Quarterly Report
D. E. Stittsworth Dec. 1972 43 p
(Contract AT(29-1)-613)
(BDX-613-613-Rev) Avail: NTIS

Design, fabrication, and evaluation principles of in-process monitors to ensure high quality pulse arc, percussive arc, opposed electrode, and parallel gap welded or brazed terminations to connector pins and metal clad circuit boards are outlined. An actuator designed to overcome some of the inconsistencies encountered in percussive arc welds is discussed. Author

N73-21215# Los Alamos Scientific Lab., N.Mex.
USING THE CA3054 MWPC AMPLIFIER
D. F. Jones and E. R. Martin Nov. 1972 4 p
(Contract W-7405-eng-36)
(LA-5085) Avail: NTIS

MP-Division has designed a front end amplifier, discriminator and driver for multiwire proportional chamber signals, of which 4K have already been built for off-chamber use and another 4K are presently under construction. The circuit waveform analysis and the amplifier tune-up and troubleshooting procedure are described. Author (NSA)

N73-21216# Bendix Corp., Kansas City, Mo.
TRIMMABLE FILM RESISTORS Final Report
T. F. Barnard Sep. 1972 40 p refs
(Contract AT(29-1)-613)
(BDX-613-728) Avail: NTIS

An improved method was investigated to produce miniature electronic products having precision responses. A system of 14 trimmable thin film resistor chips, replacing over 200 different selective-value resistors, was developed. The new system features over 13 major advantages in reduced component costs, decreased production labor, and improved capabilities. With trimmable resistors costs can be reduced by a savings in parts inventory of up to 93 percent, and by a decrease in unit cost of up to 25 percent. Improved configurations include simultaneous-coated dual-side circuits, overload ranges up to 800 percent above rated wattage, plasma-enhanced deposition, a trim range from 12 ohms to 40 kilohms, and versatile divisible multiresistor wafers. Author

N73-21217# Bendix Corp., Kansas City, Mo.
JUNCTION FIELD EFFECT TRANSISTOR DEGRADATION CAUSED BY ELECTROSTATIC DISCHARGE
W. J. Kirk Dec. 1972 26 p refs
(Contract AT(29-1)-613)
(BDX-613-815) Avail: NTIS

A literature search and physical experiments were conducted to determine the effects of electrostatic discharge on four types of junction field effect transistors (JFET) that are required in new electronic assemblies. Processes and facilities necessary to ensure product performance and reliability in a low humidity manufacturing environment are examined. Special attention was given to electrostatic discharge damage to the transistors. Electrical models of the human body were devised and tests were conducted to determine approximate values of capacitance and equivalent series body resistance that can be expected at typical work stations, the electrostatic potentials that can be expected on the bodies of operators, and the effects of discharging electrostatic energy into high impedance low current JFET's that are used in the assembly. Author

N73-21218# Commissariat a l'Energie Atomique, Bruyeres-le-Chatel (France). Centre d'Etudes Nucleaires.
MATHEMATICAL MODELS FOR MOS TRANSISTORS (J AND R MODELS WITH IMAG 2)
Jean-Marie Charlot May 1972 31 p refs In FRENCH
(CEA-R-4332) Avail: AEC Depository Libraries

Modifications of existing mathematical models to J and R types to analyze all circuit configurations, particularly integrated circuits, are discussed. The circuits calculated by these modified models have good functional representation of their components and current in the transistors. Transl. by E.H.W.

N73-21219# Laboratoire Central de Recherches Thomson-CSF, Orsay (France).
ANALYSIS OF THE CHARACTERISTICS OF DIFFERENT TYPES OF FILTERS IN ORDER TO MEET THE REQUIREMENTS OF THE DTC Final Report [ANALYSE DES CARACTERISTIQUES DES DIVERS TYPES DE FILTRES EN VUE DE SATISFAIRE LES BESOINS PROPRES A DTC]
M. Chauvin [1971] 41 p refs In FRENCH
(Rept-4.387) Avail: NTIS HC $4.25

Several makes of quartz and piezoelectric ceramic components were analyzed as regards their application to bandpass filters with central frequencies 2.5 MHz and 12.5 MHz, and a passband of at least 50 KHz between -3 db points. The work included: search for possible suppliers of these components, examination

of the approved models, analysis of possible solution with a view to realizing an inexpensive miniature filter with the desired characteristics, and the realization of a breadboard model. The piezoelectric ceramic filters (with coupled resonators) were found to have a larger passband than the quartz filters. The problem of parasitic out-of-band responses still remains to be solved. Temperature stability depends on the type of ceramic material used. ESRO

N73-21220# Laboratoire Central de Recherches Thomson-CSF, Orsay (France).
S-BAND TRANSMISSION PROPERTIES OF MAGNETO-ELASTIC DELAY LINES Final Report [LIGNES A RETARD MAGNETOELASTIQUES EN TRANSMISSION (BANDE S)]
Desormiere Oct. 1971 68 p refs In FRENCH
(Rept-8.445) Avail: NTIS HC $5.50

The main properties of S-band magnetoelastic delay lines were studied with a view to designing a delay device type transmission. Four different solutions are discussed: YIG-birefringent devices, YAG-YIG-YAG devices, YIG-YAG-YIG devices, and YIG-YAG birefringent devices. Two prototypes were constructed according to the YIG-birefringent principle. These are described and their characteristics discussed. Equipment included a sampling gate, wave excitation device, a magnetic circuit with an orientation device, and a thermoregulator. ESRO

N73-21221# Laboratoire Central de Recherches Thomson-CSF, Orsay (France). Dept. Microelectronique Hyperfrequence.
STUDY OF VARICAP SILICON DIODES Final Report [ETUDE DE DIODES A STRUCTURE SPECIALE AU SILICIUM (VARICAP) COMPTE RENDU DE FIN DE CONTRAT]
P. Gibeau and A. Chapard Nov. 1971 44 p In FRENCH
(Contract DGRST-70-7-2367)
Avail: NTIS HC $4.25

The feasibility of preparing hyperabrupt silicon junction varicaps through the use of the diffusion of impurities from a double doped substrate is studied. An epitaxy process was developed for this purpose, and several diodes were manufactured. Diodes with a voltage-dependent rapidly variable capacitance similar to varicap characteristics were obtained. The double doped epitaxy process nevertheless introduces two limitations to industrial application: lack of homogeneity and extreme sensibility to electric overvoltages. ESRO

N73-21222# Laboratoire Central de Recherches Thomson-CSF, Orsay (France).
APPLICATION OF FERRITES IN HYPERFREQUENCY MICROELECTRONICS Final Report [APPLICATION DES MATERIAUX FERRITES A LA MICROELECTRONIQUE HYPERFREQUENCE RAPPORT]
M. Blanc 13 Jul. 1971 119 p refs In FRENCH
(Contract DRME-69.34.539.00.480.75.01)
(Rept-8.422) Avail: NTIS HC $8.00

The design for superhigh frequency strip transmission line circulators using ferrites is discussed. The phase shift using ferrite in the KU band was studied since phase shifting by diodes is limited to lower frequencies. Insertion of circulators in a microstrip device was investigated in order to completely eliminate coaxial screening and connectors. The insulation and circulation functions were analyzed in order to attain a broad band of, for example, 2 to 3 octaves. As a result of this study two new processes for densification of ferrimagnetic polycrystalline materials have been pointed out. The resulting materials are especially suited to application in the superhigh frequency range. ESRO

N73-21223# Laboratoire Central de Recherches Thomson-CSF, Orsay (France).
STUDY OF DEVICES USING ACOUSTIC SURFACE WAVES (RAYLEIGH WAVES) Final Report [ETUDE DE DISPOSITIFS UTILISANT LES ONDES ACOUSTIQUES DE SURFACE (ONDES DE RAYLEIGH) RAPPORT FINAL]
[1972] 153 p refs In FRENCH
(Contract DRME-70.34.080.00.480.75.01)
(Rept-4.427) Avail: NTIS HC $9.75

Dispersive delay lines, bandpass filters, and lines with delays of above 30 microseconds, utilizing surface Rayleigh waves at frequencies below 150 MHz, were examined, to determine the performance limits and the problems in manufacturing these components. It is shown that the following devices can be made: dispersive delay line with linear frequency characteristic, and pulse compression rate of 250 (range B = 50 MHz, delay T = 5 microsec, central frequency F = 125 MHz); filter with relative passband of 0.05 (B = 5 MHz, F = 100 MHz); filter with relative passband of 0.0005 (B = 50 KHz, F = 100 MHz); cos x type filter (F = 100 MHz); and line with delay longer than 30 microsec (F - 140 MHz, T = 54 microsec). ESRO

N73-21224# Defence Research Information Centre, Orpington (England).
REDUCING THE SCANNING NONUNIFORMITY IN TV TRANSMITTER TUBES
L. P. Turchenko Jan. 1973 8 p refs Transl. into ENGLISH from Tekhn. Kino i Televideniya, v. 11, 1971 p 52-55
(DRIC-Trans-2758; BR-30133) Avail: NTIS HC $3.00

A simple method is described for correcting the nonuniformity of the beam velocity in electron tubes operating in a single-line mode by means of deflecting the current pulse. Since the scanning is done along a single line, the number of control parameters in the scanning generator is reduced as there is no need to correct the nonuniformity over the entire frame. ESRO

N73-21225# Laboratoire Central de Recherches Thomson-CSF, Orsay (France). Lab. Ferrites Hyperfrequences.
BASIC STUDY OF POLYCRYSTALLINE GARNET FOR USE IN SUPERHIGH FREQUENCY DEVICES FUNCTIONING AT PEAK SUPERHIGH FREQUENCY POWER LEVEL, AS WELL AS IN UHF (A FEW HUNDRED MHz) Final Report [ETUDE DE BASE DE GRENATS POLYCRISTALLINS EN VUE DE LEUR UTILISATION DANS LES DISPOSITIES HYPERFREQUENCES FONCTIONNANT A HAUT NIVEAU DE PUISSANCE HYPERFREQUENCE MOYENNE ET DE CRETE D'UNE PART, EN BASSE FREQUENCE (QUELQUES CENTAINES DE MHz D'AUTRE PART COMPTE-RENDU DE FIN DE CONTRAT]
Roland Sroussi Nov. 1971 63 p refs In FRENCH
(Contract DGRST-70-7-2353-00-221-75-01)
Avail: NTIS HC $5.25

The influence of substitution of gadolinium, aluminum, tin, and indium on the magnetic properties and superhigh frequency behavior of garnet materials with compositions, Y Gd Ca Fe Al Sn and Y Gd Fe Al In, was investigated. The materials obtained had magnetic moments between 300 and 800 gauss and magnetization temperature stabilities in a large range of temperatures, superior to conventional garnets. Materials of this type have narrow gyroresonance lines (delta H from 60 to 90 oersteds), low dielectric losses (tg delta smaller or equal to 0.0002), and relatively elevated nonlinearity limits (delta Hk from 10 to 20 oersteds). In addition, large magnetic moment ferrite UHF garnets were obtained with 4 pi Ms larger than 1900 gauss, delta H appr. 50 oersteds, and tg delta (epsilon) smaller than 0.0001. ESRO

N73-21226# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MONOELECTRON CHARACTERISTICS OF PHOTO-MULTIPLIERS AND THEIR APPLICATIONS
Albert N. Pertsev and Aleksadr N. Pisarevskii 30 Nov. 1972 101 p refs Transl. into ENGLISH of the publ. "Odnoelektronnye Kharakteristiki Feu i Ikh Primeneniye" USSR, 1971 p 1-77
(AF Proj. 7645)
(AD-755874; FTD-HC-23-1277-42) Avail: NTIS CSCL 09/1

The report discusses results of a study of the noise characteristics of photomultipliers and their practical application. The use of photomultipliers as detectors of weak light flows (at the level of individual quanta with intensity of tens of photons per second) in different applications of optics, biophysics, radiometry, astronomy, etc. is discussed. Author (GRA)

N73-21227# Northrop Corp., Palos Verdes Peninsula, Calif. Electronics Div.
LARGE AREA DIGISPLAY SWITCHING PLATE DESIGN, FABRICATION AND TEST Final Technical Report, Apr. 1970 - May 1972
James E. Lang Jan. 1973 87 p
(Contract F30602-70-C-0162)

(AD-755938; RADC-TR-72-332; NORT-72-269) Avail: NTIS CSCL 09/1

A flat, thin CRT, which uses digital switching rather than analog deflection to position a beam, has been successfully demonstrated in a 512 x 512 element, 80 elements per inch format, thus meeting the objective of the program. This display device, the DIGISPLAY, was shown to be capable of scanning at TV rates (60 fields - 30 frames/sec). Operating in a simulated TV raster scan mode, the display has an average spot brightness of approximately 8 to 10 foot-Lamberts, a contrast ratio exceeding 32 to 1, and exhibited 4 discriminable gray levels. The four beam-scanning plates constructed for this program enable the device to be scanned by as many as 32 simultaneous writing beams. GRA

N73-21228# Illinois Univ., Urbana. Coordinated Science Lab.
HARDWARE IMPLEMENTATION OF DIGITAL FILTERS
Roger Walter Marsh Sep. 1972 79 p refs
(Contract DAAB07-67-C-0199)
(AD-755657; R-589; UILU-ENG-72-2251) Avail: NTIS CSCL 09/5

The concept of filtering analog signals using digital processing is not a new idea. However, until recently the development of digital filtering has been restricted to computer simulation programs and usually only in nonreal-time applications. The main restrictions of real-time realizations have been the cost, speed and complexity of available digital hardware. This situation is now being remedied by the rapidly developing large-scale integration (LSI) technology for digital circuitry. The large amount of digital hardware contained in the small LSI packages and the modularity obtainable from these circuits have given great impetus to the development of many new digital circuit applications, including digital filtering. Author (GRA)

N73-21229# Army Electronics Command, Fort Monmouth, N.J.
POWER CAPABILITY OF ELECTRON BEAM-SEMICONDUCTOR AMPLIFIERS USING LARGE AREA DIODES
Maurice Weiner Nov. 1972 41 p refs
(DA Proj. 1S6-62703-A-055)
(AD-755806; ECOM-4051) Avail: NTIS CSCL 09/5

Design equations have been formulated electron beam-semiconductor amplifiers in which large area diodes are used for enhancement of output power. Both Class A and Class B modes (as well as video) are treated. Both average and peak power are considered. Corrections to the doping density caused by velocity field dependence are taken into account. Numerical examples are given. Author (GRA)

N73-21230# Naval Ordnance Lab., White Oak, Md.
SECOND BREAKDOWN IN GERMANIUM GOLD-BONDED DIODES
Norman S. Cohn and Marcella C. Petree 20 Jun. 1972 37 p refs
(AD-755425; NOLTR-72-56) Avail: NTIS CSCL 09/1

Germanium gold-bonded diodes were subjected to high power submicrosecond electrical pulses simulating an Electromagnetic Pulse (EMP) environment in order to study the induced second breakdown. Terminal characteristics of the damaged units revealed the characteristic increase in leakage current and decrease in breakdown voltage usually associated with second breakdown. Closer investigation revealed, however, that several of the generally accepted ideas pertaining to this phenomenon are not valid for germanium gold-bonded diodes. In particular, the concept of filamentary shorts through the junction is inconsistent with observations. Also, the power required to cause second breakdown in the forward direction is less than that required in the reverse direction. This is shown to be due to the geometry of these devices. Other effects are described, and qualitative and quantative explanations are offered. Methods of improving burnout resistance are also indicated. Author (GRA)

N73-21231# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DISCHARGE WITH A HOLLOW CATHODE (SELECTED CHAPTERS)
B. I. Moskalev 10 Jan. 1973 111 p Transl. into ENGLISH from the book "Razryad s Polym Katodom" Moscow, 1969 p 17, 21-84, 122-133
(AF Proj. 4152)
(AD-755412; FTD-MT-24-1808-72) Avail: NTIS CSCL 20/9

Contents: Determination and classification of various types of discharge with a hollow cathode; Experimental characteristics of glow discharge with a hollow cathode; The theory of glow discharge with a hollow cathode; Gas-discharge hollow cathode lasers. GRA

N73-21232# Army Foreign Science and Technology Center, Charlottesville, Va.
USE OF RHENIUM IN CATHODE ELECTRONICS
N. A. Iofis 27 Dec. 1972 7 p Transl. into ENGLISH of unidentified Russian language article
(AD-755828; FSTC-HT-23-1205-72) Avail: NTIS CSCL 09/1

The report discusses performance of electron tube cathodes made with alloying supplements of rhenium. GRA

N73-21233# Syracuse Univ., N.Y. Dept. of Electrical and Computer Engineering.
OPTIMIZATION METHODS FOR ARRAYS OF PARALLEL WIRE ANTENNAS
Bradley J. Strait and Dah-Cheng Kuo 15 Dec. 1972 49 p refs
(Contract F19628-68-C-0180; AF Proj. 5635)
(AD-755915; AFCRL-72-0725; SR-18) Avail: NTIS CSCL 09/5

Matrix methods are applied for optimization and constrained optimization of various performance indices of arrays of straight, parallel, thin-wire antennas. Performance indices considered include directivity, maximum power gain, quality factor, and efficiency index. Constraints can be applied either to the null directions or the sidelobe levels in the resulting pattern or to another performance index. Mutual coupling is taken completely into account and no unrealistic assumptions are necessary regarding the current distributions of the array wires. Several illustrative examples are included. Author (GRA)

N73-21234# Harry Diamond Labs., Washington, D.C.
AN ANALYTICAL AND EXPERIMENTAL INVESTIGATION OF CABLE RESPONSES TO A PULSED ELECTROMAGNETIC FIELD
Werner J. Stark Dec. 1972 30 p refs
(Contract DA-1-W-62118-AD-51)
(AD-755514; HDL-TR-1618) Avail: NTIS CSCL 09/1

An investigation was performed to determine the response of several conductor arrangements to the incident field from the WRF (Woodbridge Research Facility) Biconic radiating antenna. The following measurements are described in this report: Open circuit voltage response of a single conductor; Current distribution on a single conductor; Differential open circuit voltage measurements between two conductors; Differential short circuit current measurements between two conductors. Author (GRA)

N73-21235# Stanford Univ., Calif. Microwave Lab.
SURFACE WAVE PARAMETRIC PROCESSORS AND LONG DELAY LINES Semiannual Report, 1 Apr. - 30 Sep. 1972
M. Chodorow, H. J. Shaw, G. S. Kino, D. K. Winslow, W. L. Bond, L. A. Coldren, W. R. Shreve, P. L. Adams, C. M. Fortunko, S. L. Quilici et al Dec. 1972 92 p refs
(Contract DAAB07-71-C-0145)
(AD-755943; ML-2111; ECOM-0145-3; SAR-3) Avail: NTIS CSCL 09/1

The program is concerned with research on devices for achieving long time delays and devices for parametric signal processing, both using surface acoustic waves. A two-port helical delay line is described which produces 180 microsec delay with low cross-talk, on a bismuth germanium oxide crystal plate having face dimensions of approximately 1 inch by 2 inches. A design for a 1/2 millesecond delay line of this type on a larger crystal plate is presented. Work is described on helical waveguides for surface acoustic waves whose objective is to produce multi-millisecond time delays with low cross-talk. An electric field-shorting type of waveguide, using a thin deposited silver film in a closed loop on the surface of a bismuth germanium oxide wrap-around delay line, has demonstrated low propagation loss of .065 db per microsec at 50 MHz. Author (GRA)

N73-21236# Hughes Aircraft Co., Fullerton, Calif. Systems Effectiveness Dept.
CONTACT RELIABILITY SCREENING Final Technical Report, Jan. 1971 - Aug. 1972
R. E. Schafer, T. S. Sheffield, J. R. Collins, R. W. Dueck, and T. F. Odell Griffiss AFB, N. Y. RADC Dec. 1972 157 p
(Contract F30602-71-C-0148)
(AD-755923; RADC-TR-72-326) Avail: NTIS CSCL 09/5

The objectives of this study were to determine if a relationship exists between relay intermodulation products and constriction resistance, on the one hand, and relay life, on the other and to quantify the relationship if it exists. It turns out that both I.M. products and constriction resistance are related, statistically, to relay life although the measurement of constriction resistance had a destructive effect on the contacts and hence, on relay life. However, I.M. products measurement made early in life, on both button and bifurcated type contacts, is a good predictor of relay life. These results were obtained at accelerated operating conditions. Author (GRA)

N73-21237# Westinghouse Research Labs., Pittsburgh, Pa.
FERROELECTRIC DISPLAYS Final Report, 15 Apr. 1971 - 14 Apr. 1972
Maurice H. Francombe, Shu Y. Wu, and William J. Takei Dec. 1972 90 p refs
(Contract N00014-71-C-0268; NR Proj. 215-180)
(AD-755746) Avail: NTIS CSCL 09/5

Two ferroelectric materials, single-crystal bismuth titanate and hot-pressed ceramic lead-zirconate-titanate of approximately 65:35 composition modified with lanthanum oxide (PLZT), have potential applications in non-volatile optical display and memory devices. The goal of the present program is to develop optical projection display structures (5 x 7 in.) which can function in solid-state real-time aircraft instrumentation systems. Display structures have been fabricated using both optical and matrix addressing techniques requiring optimization of the preparation and delineation of various components such as transparent or opaque conductors, photoconductors, and opaque insulators. Author (GRA)

N73-21758* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
S BAND TRANSPONDER EXPERIMENT
W. L. Sjogren (JPL), P. M. Muller (JPL), and W. R. Wollenhaupt *In its* Apollo 16 Prelim. Sci. Rept. 1972 7 p refs (For availability see N73-21729 12-14)
CSCL 09A

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see specific Physics categories.

N73-21238*# Linguistic Systems, Inc., Cambridge, Mass.
PROBLEMS CONCERNING AUTOMATIC CONNECTION OF AN AEROGENERATOR TO A NETWORK
F. Delafond Washington NASA Apr. 1973 14 p ref Transl. into ENGLISH from the Algerian Report (French Language)
(Contract NASw-2482)
(NASA-TT-F-14873) Avail: NTIS HC $3.00 CSCL 09C

Modifications were made to the 100 kW Andreau-Enfield experimental aerogenerator, supplying a three-phase network, with the results that: (1) connection to the network was automated and rendered almost instantaneous; (2) propeller starting and stopping were automated; and (3) the amplitude of pumping in high wind was reduced by altering the change-of-pitch speed of the propeller. The machine is functioning problems of power oscillations with wind gusts are still being worked on. It is believed that the aerogenerator is suitable for supplying a large network; for small networks three or more smaller machines would have to work in connection to even out power variations. Author

N73-21239# Danish Research Center for Applied Electronics, Hoersholm.
PROGRAMME FOR WIRING LISTS. WRLST$: A COMPUTER PROGRAMME FOR PRODUCING AND UPDATING WIRING-LISTS
N. Horstock Dec. 1972 50 p
(ECR-31) Avail: NTIS HC $4.50

The program WRLST$ produces and up-dates cross-reference wiring lists, which are used during the development and production of electronic instruments. The program accepts wiring data prepared in an easy and understandable format, classifies it, searches for errors, and creates the cross-reference wiring lists. The wiring lists are printed out on the terminal in A3 format with a suitable heading and paging. Author

N73-21240*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
IMPROVED FOUR PHASE LOGIC SYSTEMS Patent Application
Howard L. Petersen and Donald K. Kinell, inventors (to NASA) Filed 17 Apr. 1973 19 p
(Contract NAS9-10742)
(NASA-Case-MSC-14240-1; US-Patent-Appl-SN-351929) Avail: NTIS HC $3.00 CSCL 09C

Integrated microcircuits and a complementary four-phase logic system using complementary MOS devices are described. These devices act as switches which charge and discharge capacitors in accordance with circuit requirements without a direct connection between the power supply and ground. The system uses four basic logic networks connected between a single power line and a reference potential with each logic network employing a pair of opposite polarity MOSTs known as P-channel and N-channel. Each logic element stores its information in the stray capacitances of the MOSTs which are included as a single storage capacitor. NASA

N73-21241# Lockheed Missiles and Space Co., Palo Alto, Calif.
NOISE CHARACTERISTICS OF FUNCTIONAL CORRELATORS USING NONLINEAR ELEMENTS WITH EXPONENTIAL CHARACTERISTICS
V. I. Vinokurov and R. A. Vakker [1972] 10 p Transl. into ENGLISH from the book "Voprosy Obrabotki Slozhykh Signalov v Korrelatsionnykh Sistemakh" Moscow, Sov. Radio, 1972 p 126-140
Avail: NTIS HC $3.00, National Translations Center, John Crerar Library, Chicago, Ill. 60616

Initial hypotheses, assumptions, and methods of analysis of signal processing are treated in an estimation of the efficiency of a difference-frequency functional correlator in which a nonlinear unit with an exponential characteristic is used in place of a multiplier. This process is characterized by the output voltage being proportional to the current flowing through a semiconducting diode. The output signal to noise ratio and the actual efficiency of the functional correlator as a substitute are determined. J.M.M.

N73-21242# Joint Publications Research Service, Arlington, Va.
THE MOSCOW INSTITUTE OF ELECTRONIC ENGINEERING
L. N. Presnukhin and Vanda Beletskaya 23 Mar. 1973 12 p Transl. into ENGLISH from Ogonek (Moscow), no. 7, Feb. 1973 p 16-17
(JPRS-58550) Avail: NTIS HC $3.00

A discussion is presented of how electronics is taught at the Moscow Institute of Electronic Engineering as well as what students are to be selected for the program. Author

N73-21243# Hanford Engineering Development Lab., Richland, Wash.
RESISTIVITY MEASUREMENTS OF INSULATORS AT HIGH TEMPERATURES USING THE FOUR PROBE TECHNIQUE
R. R. Schemmel, L. D. Philipp, R. L. Gordon, and J. L. Bates Mar. 1972 42 p refs
(Contract AT(45-1)-2170)
(HEDL-TME-72-73) Avail: NTIS

Experimental measurements deomonstrated that insulation polarization and thermionic emission of test apparatus significantly reduce accuracy of dc resistivity measurements made on metal oxide electrical insulators at 900 to 2100 C. Experimental methods that will minimize these effects are described. Author (NSA)

N73-21244# Sandia Labs., Albuquerque, N.Mex.
MULTICONDUCTOR ANTENNA TRANSMISSION LINES WITH ARBITRARILY POSITIONED LOAD IMPEDANCES IN AN INCIDENT FIELD
Charles W. Harrison and Clayborne D. Taylor Oct. 1972 24 p refs Sponsored by AEC Prepared in cooperation with Miss. State Univ., State Coll.
(SC-R-72-2695) Avail: NTIS

The characteristics of a multiple conductor transmission line with arbitrarily positioned impedances in series with each wire are described. The currents in each of the loads in terms of the amplitude of the incident electric field are analyzed. A theory for N wire structures when the impedances are situated at the centers of the conductors is developed. If the load elements are in echelon rather than centrally positioned, it appears necessary to abandon the simultaneous integral equation approach and resort to the use of two network theorems, superposition and compensation. It is demonstrated that the results depend on a synthesis of antenna and transmission line behavior. Author

N73-21245# Bendix Corp., Kansas City, Mo.
PHOTOFABRICATION PROCESSES FOR PRINTED CIRCUITS Final Report
R. B. Hedrick Oct. 1972 52 p
(Contract AT(29-1)-613)
(BDX-613-496) Avail: NTIS

Photofabrication is that part of the printed circuit board manufacturing process involving photo-resist application, curing, exposing, developing, and removal. The primary purpose of this process development project was the elimination of photo-resist breakdown during plating operations which resulted in a speckled pattern of plating modules over the resist coated surface. Removal of these nodules by picking was a time consuming and tedious advantages over liquid photo-resists. The advantages of dry film resist are: (1) elimination of resist breakdown (nodules) during plating; (2) uniform thickness control which reduced exposure problems; (3) color of dry film eliminates need to dye to facilitate visual inspection; (4) viscosity variations in liquid resist eliminated; (5) cleanup of resist application equipment has been simplified; (6) no resist residue problems; (7) faster developing; and (8) elimination of a baking operation. Author

N73-21246# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
SYNTHESIS BY COMPUTER OF SEQUENTIAL SYNCHRONOUS CIRCUITS AND MULTIPLE-OUTPUT LOGICAL NETWORKS Ph.D. Thesis - Paris Univ.
Jean Papadopoulo Jun. 1972 201 p refs In FRENCH
(CEA-R-4294) Avail: AEC Depository Libraries

Computer designed sequential circuits and multiple output logical networks are described. Data cover circuit functions, matrix forms, output states, and conducting power of the circuits. Transl. by E.H.W.

N73-21247# Army Missile Command, Redstone Arsenal, Ala. Guidance and Control Directorate.
HIGH POWER PULSE TESTING OF INTEGRATED CIRCUITS
Henry B. Cook 5 Dec. 1972 60 p
(DA Proj. 1X2-222510231)
(AD-755807; RG-72-22) Avail: NTIS CSCL 09/5

The objective was to augment the competent high power pulse damage work. The failure modes and mechanisms were investigated for integrated circuits when various pin pair combinations were stressed with high power pulses. Attempts were made to correlate the parameters of the high power pulse to the time before secondary breakdown. Pre- and post-test voltage-current measurements were taken on the pin pair combinations to determine if damage had occurred. Failure analyses were performed on selected integrated circuits to determine the failure mechanisms. The predominant failure mechanism observed was flashover with associated metallization melting and alloying. Due to the complicated geometries of the integrated circuits, no correlation was evident between the time before secondary breakdown and any of the measured pulse parameters. Author (GRA)

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N73-21248 Georgia Inst. of Tech., Atlanta.
THE DEVELOPMENT OF A CONTROLLED LATERAL GUST FACILITY FOR DETERMINING THE TRANSFER FUNCTION OF A LIFTING SURFACE Ph.D. Thesis
Felton Drew Bartlett, Jr. 1972 100 p
Avail: Univ. Microfilms Order No. 72-20600

An experimental and analytical investigation is presented to illustrate the feasibility of experimentally generating a uniform simple harmonic lateral disturbance in the test section of a low-speed wind tunnel. The gust field is generated by exciting two flexible walls upstream of the test section with electrodynamic shakers. The development of the gust field, its calibration, and finally its application in determining the transfer function of a lifting surface coupled with a theoretical comparison serves to evaluate the test facility and the complete experimental procedure. A discussion of results and conclusions indicates the usefulness of this facility in determining aircraft response to gust loadings. Dissert. Abstr.

N73-21249 Oklahoma Univ., Norman.
THE ELECTRICAL SHOCK TUBE PRECURSOR Ph.D. Thesis
James Ignatius Mills, Jr. 1972 104 p
Avail: Univ. Microfilms Order No. 72-19020

Precursor waves were created and studied in helium by means of an electrically driven shock tube employing two different discharge circuit configurations. The component causes of precursive effects have been separated and identified and individually studied in detail. Parameters of basic interest such as wave speed and electron temperatures and densities have been monitored using nuclear data handling techniques and photomultipliers for the wave speeds and a revised spectral line ratio technique for the temperatures and densities. Extensive studies employing the use of a magnetic field have been conducted in order to gain insight into the thermal conduction processes acting to transfer energy to the wave front. Many investigations of the electrical properties of the wave including the use of external calibrated probes to measure the electric field strengths associated with the front have been undertaken. Dissert. Abstr.

N73-21250*# California Univ., Berkeley. Environmental Physiology Lab.
THE AUTOMATED PRIMATE RESEARCH LABORATORY (APRL) Final Report
Nello Pace and G. Dale Smith 1 Jul. 1972 225 p refs
(Contract NSR-05-003-233)
(NASA-CR-131642; EPL-72-1) Avail: NTIS HC $13.25 CSCL 14B

A description is given of a self-contained automated primate research laboratory to study the effects of weightlessness on subhuman primates. Physiological parameters such as hemodynamics, respiration, blood constituents, waste, and diet and nutrition are analyzed for abnormalities in the simulated space environment. The Southeast Asian pig-tailed monkey (Macaca nemistrina) was selected for the experiments owing to its relative intelligence and learning capacity. The objective of the program is to demonstrate the feasibility of a man-tended primate space flight experiment. J.M.M.

N73-21251*# Singer Co., Binghamton, N.Y. Simulation Products Div.
SHUTTLE MISSION SIMULATOR HARDWARE CONCEPTUAL DESIGN REPORT
J. F. Burke 23 Mar. 1973 376 p
(Contract NAS9-12836)
(NASA-CR-128885) Avail: NTIS CSCL 14B

The detailed shuttle mission simulator hardware requirements are discussed. The conceptual design methods, or existing technology, whereby those requirements will be fulfilled are

described. Information of a general nature on the total design problem plus specific details on how these requirements are to be satisfied are reported. The configuration of the simulator is described and the capabilities for various types of training are identified. Author

N73-21252*# Physics International Co., San Leandro, Calif.
EXPLOSIVELY DRIVEN HYPERVELOCITY LAUNCHER: SECOND-STAGE AUGMENTATION TECHNIQUES Final Report
Dennis W. Baum Mar. 1973 43 p refs
(Contract NAS2-5860)
(NASA-CR-114589; PIFR-245-1) Avail: NTIS HC $4.25 CSCL 22D

The results are described of a continuing study aimed at developing a two-stage explosively driven hypervelocity launcher capable of achieving projectile velocities between 15 and 20 km/sec. The testing and evaluation of a new cylindrical impact technique for collapsing the barrel of two-stage launcher are reported. Previous two-stage launchers have been limited in ultimate performance by incomplete barrel collapse behind the projectile. The cylindrical impact technique explosively collapses a steel tube concentric with and surrounding the barrel of the launcher. The impact of the tube on the barrel produces extremely high stresses which cause the barrel to collapse. The collapse rate can be adjusted by appropriate variation of the explosive charge and tubing parameters. Launcher experiments demonstrated that the technique did achieve complete barrel collapse and form a second-stage piston. However, jetting occurred in the barrel collapse process and was responsible for severe projectile damage. Author

N73-21253*# Kanner (Leo) Associates, Redwood City, Calif.
PRINCIPLES OF STEEL CONSTRUCTION ENGINEERING IN THE BUILDING AND OPERATION OF WIND DRIVEN POWER PLANTS
Helmut Voigt Washington NASA Apr. 1973 13 p ref Transl. into ENGLISH from Der Stahlbau (West Germany), v. 23, no. 8, Aug. 1954 p 184-188
(Contract NASw-2481)
(NASA-TT-F-14872) Avail: NTIS HC $3.00 CSCL 13B

The factors which affect the designing of wind-driven power plants are discussed, including purpose and nominal output, wind velocity as a function of height, wind forces as a function of height, and the torques to be expected. Design features of the ZYKLON wind-driven power plants are summarized, and sample calculations are made, based on the ZYKLON-D 30 project. The optimal shaft height for a 30-m wind turbine is found to be 50 m above ground, with a yearly output of 2,125,000 kWh at a cost of 2.68 German pfennigs per kWh. Author

N73-21254# Daresbury Nuclear Physics Lab. (England).
ADAPTATION OF THE DARESBURY LABORATORY EXPERIMENTAL MAGNET AND POWER SUPPLY SYSTEM TO COMPUTER CONTROL
W. T. Johnstone and R. W. Silversides 1972 28 p refs
(DNPL/R-22) Avail: AEC Depository Libraries

Plans for computer control of the beam lines at the Daresbury synchrotron are described. Topics include preparing a single power supply, basic considerations for control system hardware, equipment and modifications, and operation of the system. NSA

N73-21255# Brookhaven National Lab., Upton, N.Y.
NEW SUPERCONDUCTING MATERIAL FOR MAGNET APPLICATIONS
W. B. Sampson [1972] 13 p Presented at 4th Intern. Conf. on Mabnet Technol., Upton, N. Y., 19-22 Sep. 1972 Sponsored by AEC
(BNL-17193; Conf-720908-15) Avail: NTIS

The state of the art for niobium titanium composite conductors is reviewed. The properties of multifilamentary A15 conductors are described and compared with those of NbTi composities. Author (NSA)

N73-21256# Los Alamos Scientific Lab., N.Mex.
USING MULTIWIRE PROPORTIONAL CHAMBER DECODERS
E. R. Martin and D. F. Jones Nov. 1972 13 p
(Contract W-7405-eng-36)
(LA-5073) Avail: NTIS

Design and construction of the decoder units are reported for processing the signals from up to 8K active wires in a multiwire proportional chamber system, reducing these wire hits to binary information, and storing these data in an output buffer for computer consumption. The operation of these units is described from the user point of view, and how one might interface these units to various minicomputer systems is briefly discussed. Author (NSA)

N73-21257# Sandia Labs., Albuquerque, N.Mex.
CONSIDERATIONS WHEN DESIGNING, ASSEMBLING, AND OPERATING A GASEOUS HYDROGEN PRESSURE SYSTEM
C. J. M. Northrup, Jr., R. P. Wemple, and L. P. Baudoin Nov. 1972 34 p refs Sponsored by AEC
(SC-DR-72-0593) Avail: NTIS

Much of the information required to design, assemble, and operate a gaseous hydrogen system safely is scattered througout the literature in a number of diverse reports and articles. This report draws on many of these technical papers and the authors' experiences to present some of the more common problems and solutions encountered when dealing with gaseous hydrogen. Author (NSA)

N73-21258# Atomic Energy Establishment, Cairo (Egypt). Dept. of Accelerators and Plasma Physics Research.
CONSTRUCTION AND OPERATION OF CONICAL ELECTRODE DISCHARGE SYSTEM FOR SHOCK WAVE GENERATION
H. M. Mahmound, T. A. El-Khalafawy, M. S. El-Gwaily, and M. M. Masoud 1972 30 p refs
(AREAEE-149) Avail: AEC Depository Libraries

An electrically driven shock tube was used for the generation of high velocity shock waves. The characteristics of the shock tube are discussed. Physical properties of the produced shock wave were investigated. The components of the conical electrode system for generation of the shock wave are described. The shock wave velocity showed a linear variation of amperage against time and increases with the decrease of the initial gas pressure. Author

N73-21259# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany).
[ACTIVITIES OF THE DEUTSCHE FORSCHUNGS- UND VERSUCHSANSTALT FUER LUFT- UND RAUMFAHRT] Annual Report, 1971 [JAHRES-BERICHT 1971 DER DFVLR]
Jul. 1972 497 p refs In GERMAN; ENGLISH summary
Avail: NTIS HC $27.00

The main research carried out in individual laboratories and research centers is summarized briefly. Activities reported on are in the following fields: fluid mechanics, flight mechanics, flight control, structural stability, materials, structures, propulsion systems and energy conversion, electronics, atmospheric physics, space environment simulation and aerospace medicine. ESRO

N73-21260# Illinois Univ., Savoy. Aviation Research Lab.
SYNTHETIC FLIGHT TRAINING REVISITED
Beverly H. Williges, Stanley N. Roscoe, and Robert C. Williges Aug. 1972 45 p refs
(Contract F44620-70-C-0105; AF Proj. 9778)
(AD-754957; ARL-72/21/AFOSR-72-10; AFOSR-72-2463TR) Avail: NTIS CSCL 01/3

Critical issues in the development and use of synthetic flight trainers are reviewed. Degree of simulation and fidelity of simulation are discussed as key design considerations. Problems of measurement of original learning, transfer, and retention are presented. Both transfer effectiveness and cost effectiveness are described as critical factors in the evaluation of flight trainers. Recent training innovations, such as automatically adaptive training, computer-assisted instruction, cross-adaptive measurement of residual attention, computer graphics, incremental transfer effectiveness measurement, and response surface methodology,

are discussed as potential techniques for improving synthetic flight training. Author

N73-21261# Air Force Weapons Lab., Kirtland AFB, N.Mex.
AVIAN HAZARDS TO THE AIR FORCE ROCKET SLED TEST TRACT, HOLLOMAN AFB, NEW MEXICO Technical Report, 23 Jan. 1970 - 10 Jun. 1972
Rutherford C. Wooten, Michael L. Boulter, and William M. Floyd Feb. 1973 29 p
(AD-755833; AFWL-TR-72-241) Avail: NTIS CSCL 14/2

Bird-rocket sled collisions at the rocket-sled test track at Holloman AFB, New Mexico, have resulted in severe damage to rocket sleds and ancillary equipment. The ecotonal location of the track, together with abundant water supplies created by the water braking system and an artificial rain field, is instrumental in attracting a large avifaunal population. Of the 41 species observed in the test track vicinity, house finches, horned larks, lark buntings, loggerhead shrikes, scaled quail, mourning doves, and western meadowlarks are most abundant. The bird population is greatest in autumn due predominantly to an influx of migratory horned larks. Techniques which may effectively reduce the incidence of birds in the test track vicinity include habitat manipulation designed to reduce sunflowers and other herbs and seeds on which local birds feed; the reduction of standing water in the test track braking channel; and the establishment of alternate food and water sources away from the test track.
Author (GRA)

N73-21262# Federal Electric Corp., Vandenberg AFB, Calif.
SYSTEMS PERFORMANCE AND ACCURACY REPORT
Space and Missile Test Center Mar. 1972 324 p refs
(Contract F04701-72-C-0102)
(AD-755916; SAMTEC-TR-72-1; SAMSO-TR-73-78) Avail: NTIS CSCL 16/1

Systems performance and accuracy data are presented for the Air Force Space - Missile Test Center instrumentations systems. These landbased and shipboard systems include radar, optical, telemetry timing and ship positioning systems. A section of this report is devoted to the presentation of reliability and maintainability data for these instrumentation systems. Radar random error and bias estimates are presented. Metric data accuracies are presented for the landbased optical systems. Accuracy statements for the ship positioning systems are also given. Telemetry performance data is given in terms of Figure of Merit for each landbased telemetry station. This Figure of Merit value is used to predict data quality for the designated stations. Range timing delays and uncertainties are presented for various landbased and shipboard instrumentation systems. The reliability and maintainability section contains MTBF and MTTR predictions and trends for the landbased and shipboard instrumentation systems. Author (GRA)

N73-21030 Royal Aircraft Establishment, Bedford (England).
RAE EXPERIENCE IN THE USE OF A PILOTED GROUND-BASED SIMULATOR FOR HELICOPTER HANDLING STUDIES
T. Wilcock *In* AGARD Advanced Rotorcraft, Vol. 1 Feb. 1973 12 p refs (For availability see N73-21008 12-02)

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N73-21263 Illinois Univ., Urbana.
THE VISCOUS INTERACTION WITHIN THE HYPERSONIC RAREFIED GAS FLOW REGIME Ph.D. Thesis
Kenneth Edmund Kasza 1972 72 p
Avail: Univ. Microfilms Order No. 72-19860

The non-similar boundary layer equations, as they pertain to the problem of hypersonic rarefied flow over a sharp leading edge flat plate with velocity slip and temperature jump at the wall, were integrated by employing Meksyn's asymptotic method of integration. Separate solutions for the upstream and downstream flow regions are obtained. The pressure plateau in the merged layer region, where the phenomenon of incomplete compression strongly dictates the flow behavior, is successfully predicted. In the far downstream region, with the insertion of an inviscid region between the boundary layer and the shock wave, the solution merges smoothly with the strong interaction solution. Detailed information about developing velocity profiles, shock location, and shock wave angle is also obtained. Comparisons with the available experimental data show good agreement in most of the flow properties. In addition, the problem of low speed slip flow over a wedge was examined and also solved.
Dissert. Abstr.

N73-21264 Georgia Inst. of Tech., Atlanta.
LOW REYNOLDS NUMBER FLOW PERPENDICULAR TO A CIRCULAR CYLINDER WITH SURFACE MASS TRANSFER Ph.D. Thesis
Han-Chuan Wu 1972 112 p
Avail: Univ. Microfilms Order No. 72-19715

A study of low Reynolds number flow perpendicular to a circular cylinder with constant radial suction mass flux at the surface was carried out by a numerical method. The system considered was a binary solution of A and B flowing perpendicular to the cylinder with one component, say B, being removed at the surface. The investigation was limited to high Schmidt numbers and Reynolds numbers from 0.5 to 10. The purpose of this study was to determine the concentration buildup along the cylindrical surface, the local and overall mass-transfer coefficients at the wall, and the effects of constant radial suction mass flux on the flow pattern, drag coefficient, and the surface pressure distribution. This study required the solution of the Navier-Stokes equation, the equation of continuity, and the diffusion equation, subject to specified boundary conditions. The solution was obtained by numerical means. Dissert. Abstr.

N73-21265 Mississippi State Univ., State College.
RESPONSE OF THE LAMINAR BOUNDARY LAYER TO SUPERPOSED UNSTEADINESS ON A YAWED INFINITE FLAT PLATE IN AN ADVERSE PRESSURE GRADIENT Ph.D. Thesis
N. S. Kiran 1972 159 p
Avail: Univ. Microfilms Order No. 72-20271

An analytic investigation has been performed on the response of the laminar boundary layer to superposed unsteadiness on a yawed infinite flat plate in an adverse pressure gradient flow. The form of the unsteadiness has not been specified in the formulation of the problem except that it is assumed to be small in magnitude in comparison with the steady flow. Solutions are obtained for the uncoupled equations by series expansion methods using a function of time as the basis of expansion. This reduces the problem to solving the steady non-linear chordwise flow equations and as many linear equations as required to obtain sufficient accuracy for both the chordwise and the spanwise flow. Dissert. Abstr.

N73-21266 Oregon State Univ., Corvallis.
A METHOD OF CALCULATING NONSTEADY COMPRESSIBLE FLOW IN A PROPULSIVE DUCT Ph.D. Thesis
Lawrence Decker Winiarski 1972 140 p
Avail: Univ. Microfilms Order No. 72-18875

A numerical technique is presented for solving the gas dynamics of a pulsating combustor. The computer solution which is developed follows directly from the fundamental conservation laws applied to discrete volumes rather than attempting either to finite the resulting partial differential equations, or to apply the Method of Characteristics. The integration procedure closely relates to the physical model, and various types of boundary conditions and diffusion effects can be included. The addition of diffusion terms also helps to dampen oscillations caused by near discontinuities in the flow field, spreading these discontinuities over several cell widths. Combustion processes are included in the computer solution by following the concentrations of the injected fuel and the oxygen aspirated from the atmosphere, and computing the energy released when the fuel ignites.
Dissert. Abstr.

N73-21267 Case Western Reserve Univ., Cleveland, Ohio.
FLUID MECHANICS OF NONCONTACTING GAS FILM

SEALS Ph.D. Thesis
John Zuk 1972 414 p
Avail: Univ. Microfilms Order No. 72-18748

The leakage and pressure drop characteristics across the dam of a gas film seal are discussed. Methods are developed which enable analysis of a much wider range of seal operating conditions to include: (1) laminar or turbulent flows, (2) subsonic or choked flows, (3) parallel or deformed sealing faces, and (4) constant or variable area. It was determined that a finite element method with a Galerkin solution technique was formulated.
Dissert. Abstr.

N73-21268 Texas Univ., Austin.
A STUDY OF THE STRUCTURE OF COLLISIONLESS SHOCK WAVES PROPAGATING PERPENDICULAR TO AN INITIAL FIELD Ph.D. Thesis
Perry Edward Phillips 1971 137 p
Avail: Univ. Microfilms Order No. 72-19648

An experimental study of the structure of collisionless shock waves was carried out on an oblique shock apparatus. A brief review of the structure of shock waves is presented, starting from ordinary gas dynamic shocks and progressing to the structure of collisionless shock waves. Calculations of the effects of various dissipative mechanisms on the shock thickness were performed. A comprehensive experimental study of the structure of low to intermediate strength shocks was conducted. Special emphasis was placed on understanding the double structure previously observed in shocks for low beta plasmas. Dissert. Abstr.

N73-21269 Iowa State Univ. of Science and Technology, Ames.
NUMERICAL SIMULATION OF AXISYMMETRIC VORTEX FORMATION NORMAL TO A SOLID BOUNDARY Ph.D. Thesis
Denny Scott Chaussee 1972 208 p
Avail: Univ. Microfilms Order No. 72-19980

An atmospheric vortex was simulated numerically for Reynolds numbers of 133, 1,000 and 10,000. During the time of development of the vortex, approximately the first 13 minutes, the flow fields evolves from an initial updraft centered on the axis of rotation of the initial circulation distribution (simulating a tornado low), to the development of local maxima of both circulation and tangential velocity located near the axis of rotation. This development caused a vortex to form which is comparable in pattern and shape to a typical strong atmospheric vortex (Rankine-combined vortex). The boundary conditions and parameter values of the numerical model were selected by analyzing and using the information from sightings of strong atmospheric vortices such as tornadoes and waterspouts. A mathematical form for the updraft was derived using values for the velocities that occur in a strong thunderstorm.
Dissert. Abstr.

N73-21270 Washington Univ., Seattle.
CONSEQUENCES OF MICROSCOPIC SYMMETRIES AND LINEAR RESPONSE THEORY FOR THE HYDRODYNAMICS OF SUPERFLUID HELIUM Ph.D. Thesis
Michael Owen Fryer 1972 94 p
Avail: Univ. Microfilms Order No. 72-20865

The hydrodynamic properties of liquid helium are discussed. The properties are described by two fluid hydrodynamics and by quantum statistical mechanics. It was determined how the two fluid hydrodynamic equations are modified by the presence of external fields. The specific fields considered are those which couple to the thermodynamic variables of helium and those which create and destroy particles. The form of the hydrodynamic equations for these fields is found by physical reasoning for the gravitational field case. For other types of fields additional terms involving undetermined parameters are added to the hydrodynamic equations. Dissert. Abstr.

N73-21271 National Lending Library for Science and Technology, Boston Spa (England).
CALCULATION OF ACOUSTIC AMPLIFICATION IN COMPLEX CIRCUITS: APPLICATION TO HEAT EXCHANGER VIBRATIONS IN CHINON 3
G. Baylac et al 10 Nov. 1972 47 p refs Transl. into ENGLISH from Houille Blanche (France), no. 5, 1971
(NLL-CE-TRANS-5913-(9022.09)) Avail: Natl. Lending Library, Boston Spa, Engl.: 5 NLL photocopy coupons

Noise sources in fluid circuits are examined and the principles for calculating their amplification are presented. Results are applied to examine vibrations in the heat exchangers of the Chinon III reactor. Author

N73-21272*# General Dynamics/Fort Worth, Tex. Convair Aerospace Div.
THE APPLICATION OF GENERAL AERODYNAMIC LIFTING SURFACE ELEMENTS TO PROBLEMS IN UNSTEADY TRANSONIC FLOW
Atlee M. Cunningham, Jr. Feb. 1973 124 p refs
(Contract NAS1-11565)
(NASA-CR-112264) Avail: NTIS HC $8.25 CSCL 20D

A study was conducted to investigate the feasibility of using combined subsonic and supersonic linear theory as a means for solving unsteady transonic flow problems in an economical and yet realistic manner. With some modification, existing linear theory methods are combined into a single program and a simple algorithm is derived for determining interference between lifting surface elements of different Mach number. The method is applied to a wide variety of problems for which measured unsteady pressure distributions and Mach number distributions are available. By comparing theory and experiment, the transonic method solutions show a significant improvement over uniform flow solutions. It is concluded that with these refinements the method will provide a means for performing realistic transonic flutter and dynamic response analyses at costs which are compatible with current linear theory based solutions. Author

N73-21273*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
EVALUATION OF FLEXIBLE RING BAFFLES FOR DAMPING LIQUID OSCILLATIONS
Frank Bugg 12 Jan. 1973 34 p refs
(NASA-TM-X-64730) Avail: NTIS HC $3.75 CSCL 20D

An experimental study was undertaken of damping produced by single flexible-ring baffles in a 396-cm diameter tank of liquid nitrogen. Two 24.8-cm wide baffles were tested. One baffle was 0.00635 cm thick type 301 stainless steel and the other 0.0254 cm thick Teflon FEP. Each baffle produced damping of liquid oscillations equal to or greater than that expected from rigid baffles of the same size. The equations used to determine the baffle thickness required were found to be adequate baffle design equations. Author

N73-21274*# Linguistic Systems, Inc., Cambridge, Mass.
FLUID MECHANICS: NOTE ON SURFACE INSTABILITIES
J.-L. Champetier, J.-C. Larger, Y. Leclanche, and P. Nelson Washington NASA Apr. 1973 7 p ref Transl. into ENGLISH from Compt. Rend. (France), v. 261, no. 15, 11 Oct. 1965 p 2825-2828
(Contract NASw-2482)
(NASA-TT-F-14880) Avail: NTIS HC $3.00 CSCL 20D

The stability of movement of the surface of a liquid layer subjected to motion in a direction perpendicular to its faces is studied, when this surface is not rigorously planar. It is shown that, for time intervals less than 0.00001 sec, viscosity and surface tension are negligible. A deceleration of the motion of the whole ensemble is a destabilizing influence and the velocity of deformation increases proportionally with the order of the perturbation. This occurrence explains the existence of jets at the point where there are defects in the liquid layer. Author

N73-21275# Lockheed Missiles and Space Co., Palo Alto, Calif.
NATURAL VIBRATIONS OF A STRATIFIED FLUID IN VESSELS
V. S. Gontkevich [1972] 5 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekhan. Zhidk. i Gaza (Moscow), no. 1, 1973 p 147-152
Avail: NTIS HC $3.00; National Translations Center, John Crerar Library, Chicago, Ill. 60616

The natural vibrations of a stratified fluid in a rectangular vessel are investigated. The vibrations of an ideal incompressible fluid separated into layers of different density are considered as the limit case of stratification. A frequency equation is obtained for an arbitrary number of layers. The vibrations equation is solved numerically on an electronic computer for a continuous

density distribution. The results of a computation for a sinusoidal density distribution law are compared with the data for an exponential law when there is an exact solution. Author

N73-21276*# Cincinnati Univ., Ohio. Dept. of Aerospace Engineering.
THREE-DIMENSIONAL COMPRESSIBLE LAMINAR BOUNDARY LAYERS ON SHARP AND BLUNT CIRCULAR CONES AT ANGLE OF ATTACK Final Report
Zenon Popinski and R. T. Davis Jan. 1973 125 p refs
(Contract NAS1-11104)
(NASA-CR-112316) Avail: NTIS HC $8.25 CSCL 20D

A method for solving the three-dimensional compressible laminar boundary layer equations for the case of a circular cone and a sphere-cone body at an angle of attack is presented. The governing equations are modified by a similarity type transformation and then transformed into a Crocco-type form. The resulting set of equations is solved simultaneously by an iterative method using an implicit finite difference scheme by means of an efficient algorithm for equations of tridiagonal form. The effects of streamline swallowing on a sharp cone are included by introducing the true inviscid edge conditions at the distance from the wall equal to the boundary layer thickness. The validity of the approach was established by comparison of the computational results with similar results by other methods and with experimental data. It was concluded that at sufficiently high Mach number and moderate to large angles of attack, the streamline swallowing effects on a sharp cone result in higher values of skin friction and heat transfer as compared with the classical results for constant entropy. Author

N73-21277*# Cincinnati Univ., Ohio. Dept. of Aerospace Engineering.
THE USE OF LEVY-LEES VARIABLES IN THREE-DIMENSIONAL BOUNDARY-LAYER FLOWS Final Report
Veer Narain Vatsa and R. T. Davis Jan. 1973 73 p refs
(Contract NAS1-11104)
(NASA-CR-112315) Avail: NTIS HC $5.75 CSCL 20D

A method for solving a general class of three-dimensional boundary layer flows is developed. In the development, Levy-Lees variables are extended to three dimensions and equations are placed in these similarity variables. An implicit finite difference scheme which is stable for negative transverse velocities is used to solve these equations. The method developed is applied to obtain solutions for sharp and spherically blunted circular cones at angle of attack. Longitudinal and transverse distributions are presented for these cases. Good agreement is found with the results obtained by other numerical schemes and the experimental data of Tracy, for sharp circular cones at angle of attack. For spherically blunted cones at angle of attack, the results are in good agreement with axisymmetric sphere results up to the region where spherical symmetry holds. Author

N73-21278*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
NUMERICAL AND EXPERIMENTAL STUDIES OF THE NATURAL CONVECTION FLOW WITHIN A HORIZONTAL CYLINDER SUBJECTED TO A UNIFORMLY COLD WALL BOUNDARY CONDITION Ph.D. Thesis - Va. Poly. Inst. and State Univ.
Roger Bell Stewart Oct. 1972 140 p refs
(NASA-TM-X-69220) Avail: NTIS HC $9.00 CSCL 20D

Numerical solutions are obtained for the quasi-compressible Navier-Stokes equations governing the time dependent natural convection flow within a horizontal cylinder. The early time flow development and wall heat transfer is obtained after imposing a uniformly cold wall boundary condition on the cylinder. Solutions are also obtained for the case of a time varying cold wall boundary condition. Windware explicit differencing is used for the numerical solutions. The viscous truncation error associated with this scheme is controlled so that first order accuracy is maintained in time and space. The results encompass a range of Grashof numbers from 8.34 times 10,000 to 7 times 10 to the 7th power which is within the laminar flow regime for gravitationally driven fluid flows. Experiments within a small scale instrumented horizontal cylinder revealed the time development of the temperature distribution across the boundary layer and also the decay of wall heat transfer with time. Author

N73-21279*# Scientific Translation Service, Santa Barbara, Calif.
PULSATING FLOW THROUGH PIPES
F. Schultz-Grunow Washington NASA 26 Apr. 1973 50 p refs Transl. into ENGLISH from Forsch. (Ger.), v. 11, no. 4, 1940 p 170-187
(Contract NASw-2483)
(NASA-TT-F-14881) Avail: NTIS HC $4.50 CSCL 20D

Tests on pulsating flow through straight pipes are reported. Investigations also cover instantaneous flow states and friction conditions of the turbulent friction layer in the case of nonstationary flow. Author

N73-21280*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
THE BEHAVIOR OF A COMPRESSIBLE TURBULENT BOUNDARY LAYER IN A SHOCK-WAVE-INDUCED ADVERSE PRESSURE GRADIENT Ph.D. Thesis - Washington Univ., Seattle, Aug. 1972
William C. Rose Washington Mar. 1973 236 p refs
(NASA-TN-D-7092; A-4554) Avail: NTIS HC $3.00 CSCL 20D

The results of an experimental investigation of the mean- and fluctuating-flow properties of a compressible turbulent boundary layer in a shock-wave-induced adverse pressure gradient are presented. The turbulent boundary layer developed on the wall of an axially symmetric nozzle and test section whose nominal free-stream Mach number and boundary-layer thickness Reynolds number were 4 and 100,000, respectively. The adverse pressure gradient was induced by an externally generated conical shock wave. Mean and time-averaged fluctuating-flow data, including the complete experimental Reynolds stress tensor and experimental turbulent mass- and heat-transfer rates are presented for the boundary layer and external flow, upstream, within and downstream of the pressure gradient. The mean-flow data include distributions of total temperature throughout the region of interest. The turbulent mixing properties of the flow were determined experimentally with a hot-wire anemometer. The calibration of the wires and the interpretation of the data are discussed. From the results of the investigation, it is concluded that the shock-wave - boundary-layer interaction significantly alters the turbulent mixing characteristics of the boundary layer. Author

N73-21281# Joint Publications Research Service, Arlington, Va.
CALCULATION OF TWO-DIMENSIONAL FLOWS WITH DETONATION
V. Ya. Goldin, N. N. Kalitkin, Yu. L. Levitan, and B. L. Rozhdestvenskiy 10 Apr. 1973 11 p refs Transl. into ENGLISH from Akad. Nauk SSSR, Zh. Vychislitelnoy Mat. i Matematicheskoy Fiz. (USSR), v. 12, no. 6, Nov. - Dec. 1972 p 1606-1611
(JPRS-58699) Avail: NTIS HC $3.00

A discussion is presented of the difference method developed for calculation of two-dimensional gas dynamics problems with detonation. Author

N73-21282*# New York Univ., N.Y. Dept. of Aeronautics and Astronautics.
SUPERSONIC FLOW CALCULATIONS FOR A CONE WITH AN ELLIPTIC FLARE
Harry Lehrhaupt Jun. 1970 51 p ref
(Grant NGR-33-016-131)
(NASA-CR-112301; NYU-AA-70-16) Avail: NTIS HC $4.75 CSCL 20D

A three-dimensional supersonic flow program is presented for calculating the flow field about a cone at zero angle of attack with an elliptical flare. The program is irrotational, and results remain valid in the region ahead of the first reflected characteristic from the points of shock where the shock is no longer axisymmetric. F.O.S.

N73-21283# Oklahoma Univ., Norman.
AN EXPERIMENTAL STUDY OF THE EFFECTS OF LOW BOND NUMBER SLOSHING ON THERMAL STRATIFICATION
Robert J. Krane 10 Oct. 1972 37 p refs Backup document for AIAA Synoptic scheduled for publication in AIAA Journal in Sep. 1973 Sponsored in part by McDonnell-Douglas Corp.
Avail: NTIS HC $4.00

The results of a study of the effects of low Bond number (simulated low gravity) sloshing on thermally stratified liquids contained in right circular cylindrical tanks are given. The experiments were run in a 1-g environment using water in a small diameter tank to achieve a moderately low value of the Bond number. The tank was mounted directly on the head of an electrodynamic shaker and vibrated in a direction perpendicular to its longitudinal axis. Thermal stratification was produced by depositing a layer of hot water atop a layer of cold water. It was found that all three of the lateral sloshing modes that exist near the first natural frequency of the free surface disrupt the stratified layer to some extent. The strong rotational liquid motions caused by the stable nonplanar mode provided the most destratification. Stable planar sloshing caused the smallest effects, while the unstable nonplanar mode provided intermediate degrees of destratification. Author

N73-21284*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

ANALYSIS OF THE INJECTION OF A HEATED, TURBULENT JET INTO A MOVING MAINSTREAM, WITH EMPHASIS ON A THERMAL DISCHARGE IN A WATERWAY Ph.D. Thesis - Virginia Polytechnic Inst. and State Univ., Blacksburg

James F. Campbell Dec. 1972 197 p refs

(NASA-TM-X-69221) Avail: NTIS HC $2.00 CSCL 20D

An experimental and theoretical investigation was undertaken to study the trajectory and growth of thermal effluents having a range of discharge velocities and temperatures. The discharge of a turbulent effluent into a waterway was mathematically modeled as a submerged jet injection process by using an integral method which accounts for natural fluid mechanisms such as turbulence, entrainment, buoyancy, and heat transfer. The analytical results are supported by experimental data and demonstrate the usefulness of the theory for estimating the location and size of the effluent with respect to the discharge point. The capability of predicting jet flow properties, as well as two- and three-dimensional jet paths, was enhanced by obtaining the jet cross-sectional area during the solution of the conservation equations. Realistic estimates of temperature in the effluent were acquired by accounting for heat losses in the jet flow due to forced convection and to entrainment of free-stream fluid into the jet. Author

N73-21285# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Kernverfahrenstechnik.

THEORETICAL INVESTIGATION OF A VISCOUS COMPRESSIBLE FLOW IN A CURVED NOZZLE

R. A. Duerr Sep. 1972 9 p refs In GERMAN

(KFK-1630) Avail: AEC Depository Libraries

For calculation of the flow and energy losses of pure gases in separation nozzle geometry, the Navier-Stokes equations are simplified and solved by numerical integration using the finite difference method. It is shown by comparison with pressure measurements that the results are a satisfactory approximation of the experiments, especially in the range of small and medium-size deflection angles. The flow entering the nozzle tangential to the deflection wall adapted itself to the curved nozzle after approximately 30 deg of deflection and did not show major deviations from a parabolic shape in the azimuthal velocity profile below Reynolds numbers of 200. The temperature curve largely corresponded to that of an isoenergetic flow. Quantitatively, the entropy calculations agreed with the behavior measured in the experiment. Analysis of the distribution of losses within the separation element shows the losses to be highest in the initial third of the nozzle, due to the steep velocity gradient and the shape of the inlet profile. Author (NSA)

N73-21286# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Neutronenphysik und Reaktortechnik.

INVESTIGATION OF THE TURBULENCE AND SHEAR STRESS IN A CIRCULAR CHANNEL WITH A HOT WIRE ANEMOMETER

K. Rehme Jul. 1972 41 p refs In GERMAN; ENGLISH summary

(KFK-1642) Avail: AEC Depository Libraries

A test was performed in a circular channel on the use of a hot wire anemometer for the experimental investigation of shear stress and turbulence of turbulent flow. For circular tubes the shear stress distribution can be obtained theoretically. For the evaluation of the data a method developed by B. Kjellstrom is adopted. The measurements were conducted for Reynolds numbers ranging between 2 x 10,000 and 2 x 100,000 at a position of 75 tube diameters. The experimental results of the shear stress distribution are in excellent agreement with the theoretical values; the experimental turbulence intensities are in very good agreement with the data published in the literature. Author (NSA)

N73-21287# Institut Franco-Allemand de Recherches, St. Louis (France).

BLAST WAVE PROPAGATION IN TUNNELS. PART 4: CALCULATIONS TAKING INTO ACCOUNT WALL ROUGHNESS [PROPAGATION DES SOUFFLES EN GALERIE. QUATRIEME PARTIE: CALCULS TENANT COMPTE DE LA RUGOSITE DE LA PAROI]

L. Bobin 24 Jul. 1972 87 p refs In FRENCH

(Contract DTEN-71.70.181)

(ISL-17/72-Pt-4) Avail: NTIS HC $6.50

A computer program based on the method of characteristics to study the blast load propagation and attenuation in shock tunnels where the air is assumed to act as a perfect gas, is presented. The friction coefficients introduced in the flow equations are discussed. Results obtained by experiments and computation methods were compared, discussed and found to agree on a small scale. Future study using strong shock waves propagating at large distances is recommended. In addition it is suggested to use tables of the air in chemical equilibrium including second virial corrections instead of the perfect gas equation of state to improve the prediction of shock wave attenuation. ESRO

N73-21288# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Freiburg (West Germany). Inst. fuer Angewandte Mathematik und Mechanik.

INVESTIGATION OF TRANSPORT PHENOMENA RELAXATION OF INTRAMOLECULAR DEGREES OF FREEDOM AND CHEMICAL REACTIONS IN A ONE-DIMENSIONAL STATIONARY SHOCK WAVE [EINDIMENSIONALER UND STATIONAERER VERDICHTUNGSSTOSS UNTER BERUECKSICHTIGUNG DER TRANSPORTERSCHEINUNGEN, DER RELAXATIONEN DER INNEREN MOLEKUELFREIHEITSGRADE UND DER CHEMISCHEN REAKTIONEN]

Lothar Wassner Oct. 1972 138 p refs In GERMAN; ENGLISH summary

(DLR-FB-72-54) Avail: NTIS HC $19.00; DFVLR, Porz, West Ger. 38,30 DM

A nonlinear system of differential equations which governs the one-dimensional steady flow across a normal shock wave was treated. Transport phenomena, relaxation of the intramolecular degrees of freedom of vibration and rotation, and chemical reactions were considered. Because the stiff-system type is unsteady, application of the numerical standard integration procedure failed. An integration method was derived and used successfully. The results can be applied to the thermodynamic and flow mechanic situation in and behind a compressive shock at hypersonic flight. ESRO

N73-21289# Michigan Univ., Ann Arbor. Dept. of Engineering Mechanics.

SPECTRAL THEORY OF TAYLOR VORTICES. PART 2: PROOF OF NONOSCILLATION

Chia-Shun Yih 17 Jan. 1972 17 p Repr. from Arch. Ration. Mech. Anal. (West Germany), v. 47, no. 4, 1972 p 288-300 Revised Sponsored in part by NSF

(Contract N00014-67-A-0181-0038; NR Proj. 062-448)

(AD-754480) Avail: NTIS CSCL 20/4

It is shown, by the method of evolution of eigenvalues and the method of analytic continuation, that Taylor vortices occurring in Couette flows are nonoscillatory, provided the square of the circulation decreases outwards. Author (GRA)

N73-21290# Polytechnic Inst. of Brooklyn, Farmingdale, N.Y. Dept. of Aerospace Engineering and Applied Mechanics.

VISCOUS FLOW OVER A CONE AT MODERATE INCIDENCE. 2: SUPERSONIC BOUNDARY LAYER

T. C. Lin and S. G. Rubin Sep. 1972 102 p refs

(Grant AF-AFOSR-1843-70; AF Proj. 9781)

(AD-755862; PIBAL-72-27; AFOSR-73-0219TR) Avail: NTIS CSCL 20/4

A numerical finite difference method recently developed to study three-dimensional viscous flow is applied here to the supersonic flow over a sharp cone at moderate angles of incidence ($a/\theta < 2$, a = angle of attack, θ = cone half angle). In a previous analysis, the hypersonic merged and strong interaction regions were considered. In this paper the supersonic boundary layer farther downstream is evaluated. The system of governing equations incorporates lateral diffusion and centrifugal force effects; and an improved numerical scheme has been developed. Detailed flow structure including surface heart transfer, boundary layer profiles and thickness, and the formation of swirling pairwise symmetric vortices, associated with crossflow separation are obtained. GRA

N73-21291# Aix-Marseilles Univ. (France). Inst. de Mecanique Statistique de la Turbulence.

INVESTIGATION OF TURBULENCE: EQUATIONS FOR COMPRESSIBLE GAS, SPACE-TIME CORRELATIONS IN A BOUNDARY LAYER Final Report, 1 Jan. 1967 - 31 Jan. 1972

Alexandre J. Favre Feb. 1972 13 p refs
(Contract F61052-67-C-0025; AF Proj. 9781)
(AD-755889; AFOSR-73-0240TR; QR-8) Avail: NTIS CSCL 20/4

Statistical equations for a turbulent compressible gas are given: (a) in a generalized form, the complete definitions of the non-random parts of the turbulent quantities being kept free for a later stage; (b) in the conventional form, the non-random parts being defined by the mean values of the turbulent quantities; and (c) in a form which is much simpler for mathematical treatment and physical meaning, where the non-random parts of the extensive turbulent quantities are defined by the mean mass-weighted values. Space-time correlations in a subsonic turbulent boundary layer without and with heat transfer have been measured. Triple correlations of velocities are especially significant of the structure of large scale fluctuations. Author (GRA)

N73-21292# Douglas Aircraft Co., Inc., Long Beach, Calif.

CALCULATION OF POTENTIAL FLOW ABOUT ARBITRARY THREE DIMENSIONAL LIFTING BODIES: USER'S MANUAL

Dun-Pok Mack Oct. 1972 81 p
(Contract N00019-71-C-0524)
(AD-755933; MDC-j5679-02) Avail: NTIS CSCL 20/4

The report contains all the necessary information to run the lifting three dimensional potential flow program. The program is written in FORTRAN IV language and is set up to be run on the IBM 370 system. The input considerations discussed in this report are: the body surface, Kutta points, off-body points, and other pertinent information for the lifting sections. Load sheets and detailed deck set-ups are illustrated. The output interpretation and the required external storage are also discussed. A check list for case set up is provided, and a sample test case and its output are shown as an example. GRA

N73-21293# Army Foreign Science and Technology Center, Charlottesville, Va.

VIBRATION OF A PLATE OVER A LAYER OF A VISCOUS HEAT CONDUCTING GAS

E. B. Rabinovich and A. I. Snopov 25 Aug. 1972 12 p Transl. into ENGLISH from Mashinovedenie (USSR), no. 3, 1970
(AD-755288; FSTC-HT-23-398-72) Avail: NTIS CSCL 20/4

When gas supports with respect to vibro-stability are calculated it is necessary to consider the heat process of the work of the supports because, in general, compression and expansion of the gas are followed by changes in its temperature. A complete study of the non-stationary flow of a viscous heat-conducting gas within slip gas supports presents considerable difficulties due to the non-linearity of the differential equations that describe the gas motion. The study looks at the case of the non-stationary gas flow between parallel vibrating plates on the basis of the exact equations of hydrodynamics with the ph-method, and the effect of heat transfer and inertial forces on the compression effect is brought out. Calculations show that when the temperature of at least one plate is maintained constant, the state of the gas is close to isothermal. Inertial effects in the laminar layer are negligibly small during moderate amplitudes of oscillation. GRA

N73-21294# Naval Ordnance Lab., White Oak, Md.

AN EXPERIMENTAL INVESTIGATION OF THE LAMINAR BOUNDARY LAYER ON A SPINNING OGIVE CYLINDER IN SUPERSONIC FLOW

William C. Ragsdale, Michael A. Brown, and Robert G. Ball 1 Nov. 1972 134 p refs
(AD-755694; NOLTR-72-265) Avail: NTIS CSCL 19/1

Pitot pressure surveys were made of the laminar boundary layer on an ogive-cylinder model at Mach 3.02 and 4.10. Surveys were made at five stations along the model, at angles of attack of zero and four degrees, with and without spin. Tests with spin were performed at Mach 3.02. The pitot pressure data has been used to compute boundary-layer velocity profiles, and results from two data-reduction procedures are presented. Some comparisons are made with theoretical velocity profiles for the zero spin, zero angle-of-attack case. Author (GRA)

N73-21295# ARO, Inc., Arnold Air Force Station, Tenn.

INVESTIGATION OF THE EFFECTS OF NOSE BLUNTNESS ON NATURAL AND INDUCED BOUNDARY LAYER TRANSITION ON AXISYMMETRIC BODIES IN SUPERSONIC FLOW Final Report

Jack D. Coats AEDC Feb. 1973 64 p refs
(AD-755843; AEDC-TR-73-36; ARO-VKF-TR-70-224) Avail: NTIS CSCL 20/4

A series of tests has been conducted at free-stream Mach numbers four and eight to determine the effectiveness of three-dimensional boundary-layer trips in promoting transition on very blunt axisymmetric bodies with near equilibrium wall temperatures. Temperature distributions obtained with temperature sensing gages inserted in the model surface were used to locate boundary-layer transition at Mach number four, and qualitative results, based on pitot pressure measurements, were obtained at Mach number eight. A simple modification of a technique proposed by van Driest and Blummer for determining an effective trip size for blunt bodies is shown to yield a correlation applicable to their data on a sphere at Mach number two and the present configurations at Mach number four. Author (GRA)

N73-21488* Translation Consultants, Ltd., Arlington, Va.

THE STRUCTURE OF SHOCK WAVE IN A GAS CONSISTING OF IDEALLY ELASTIC, RIGID SPHERICAL MOLECULES

F. G. Cheremisin *In its* Numerical Methods in the Theory of Rarefied Gases Jul. 1972 p 64-78 refs (For availability see N73-21483 12-19)
CSCL 20D

N73-21492* Translation Consultants, Ltd., Arlington, Va.

TRANSFER PHENOMENA IN REACTING GAS MIXTURES

B. V. Alekseyev *In its* Numerical Methods in the Theory of Rarefied Gases Jul. 1972 p 147-179 refs (For availability see N73-21483 12-19)
CSCL 20D

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N73-21296 Maryland Univ., College Park.

PARTIALLY COVARIANT QUANTUM THEORY OF GRAVITATION Ph.D. Thesis

Vincent Edward Moncrief 1972 107 p
Avail: Univ. Microfilms Order No. 72-18955

Argument is made for a strict law of conservation of probability for the unambiguous interpretation of any proposed quantum theory of gravitation. An alternative method of quantization is proposed which has a conventional Schrodinger equation and therefore a law of probability conservation. This result is achieved by imposing a weaker form of the quantum constraint equations than that of the conventional theory. The proposed

quantum theory is developed somewhat by considering the interaction of matter and gravitational fields. Quantum analogs of the covariant conservation laws are derived for the special case of a massive spin-zero field. Charge conservation is also considered and an invariant scheme for defining the number of particles and anti-particles is developed. Dissert. Abstr.

N73-21297 Stanford Univ., Calif.
THE STRUCTURE OF THE MAGNETOSPHERE AS DEDUCTED FROM MAGNETOSPHERICALLY REFLECTED WHISTLERS Ph.D. Thesis
Bruce Charles Edgar 1972 195 p
Avail: Univ. Microfilms Order No. 72-20701

A very low frequency (VLF) electromagnetic wave phenomenon called the magnetospherically reflected (MR) whistler is described. This study utilizes VLF (0.3 to 12.5 kHz) data obtained from the Orbiting Geophysical Observatories (OGO) 1 and 3 from October 1964 to December 1966. MR whistlers are produced by the dispersive propagation of energy from atmospheric lightning through the magnetosphere to the satellite along ray paths which undergo one or more reflections due to the presence of ions. The gross features of MR whistler frequency-time spectrograms are explained in terms of propagation through a magnetosphere composed of thermal ions and electrons and having small density gradients across L-shells. Irregularities observed in MR spectra are interpreted in terms of propagation through field-aligned density structures. Dissert. Abstr.

N73-21298 Missouri Univ., Columbia.
A STUDY OF ATMOSPHERIC ENERGY COMPUTATION BY KINEMATIC METHODS Ph.D. Thesis
Su-Tzai Soong 1972 118 p
Avail: Univ. Microfilms Order No. 72-19250

An experimental test concerning the use of the kinematic method in vertical motion and atmospheric energy computations is presented. The conversion from internal and potential energy to kinetic energy and the vertical pressure interaction of energetics were computed for a three-day period over North America. The computational methods tested in this study include: an exact polynomial method, a least squares polynomial method, a modified least squares polynomial method (method M), and a correction method (method C). The exact polynomial method sometimes gives unreasonable results. The results of the other methods are in good agreement and qualitatively more reasonable.
Dissert. Abstr.

N73-21299*# Geological Survey, Harrisburg, Pa.
NEAR REAL TIME WATER RESOURCES DATA FOR RIVER BASIN MANAGEMENT Progress Report, 1 Jul. - 31 Dec. 1972
Richard W. Paulson, Principal Investigator 24 Jan. 1973 39 p Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 Original contains color illustrations ERTS
(NASA Order S-70243-AG)
(E73-10451; NASA-CR-131253) Avail: NTIS HC $4.00 CSCL 08H

The author has identified the following significant results. Twenty Data Collection Platforms (DCP) are being field installed on USGS water resources stations in the Delaware River Basin. DCP's have been successfully installed and are operating well on five stream gaging stations, three observation wells, and one water quality monitor in the basin. DCP's have been installed at nine additional water quality monitors, and work is progressing on interfacing the platforms to the monitors. ERTS-related water resources data from the platforms are being provided in near real time, by the Goddard Space Flight Center to the Pennsylvania district, Water Resources Division, U.S. Geological Survey. On a daily basis, the data are computer processed by the Survey and provided to the Delware River Basin Commission. Each daily summary contains data that were relayed during 4 or 5 of the 15 orbits made by ERTS-1 during the previous day. Water resources parameters relays by the platforms include dissolved oxygen concentrations, temperature, pH, specific conductance, well level, and stream gage height, which is used to compute stream flow for the daily summary.

N73-21300*# Bendix Corp., Ann Arbor, Mich. Aerospace Systems Div.
INVESTIGATION OF TECHNIQUES FOR CORRECTING ERTS DATA FOR SOLAR AND ATMOSPHERIC EFFECTS Bimonthly Progress Report
Robert H. Rogers, Principal Investigator 1 Apr. 1973 29 p ERTS
(Contract NAS5-21863)
(E73-10458; NASA-CR-131258) Avail: NTIS HC $3.50 CSCL 05B

The author has identified the following significant results. A technique is described by which an ERTS investigator can obtain absolute target reflectances by correcting spacecraft radiance measurements for variable target irradiance, atmospheric attenuation, and atmospheric backscatter. A simple measuring instrument and the necessary atmospheric measurements are discussed, and examples demonstrate the nature and magnitude of the atmospheric corrections. Preliminary results indicate that the radiant power measuring instrument will provide one technique for calibrating ERTS-1 data. The March 27, 1973 mission was significant in the NASA C-130 aircraft and ERTS-1 simultaneously passed over the test sites where RPMI's were being deployed to measure solar and atmospheric parameters and site reflectance.

N73-21301*# Centre for Overseas Pest Research, London (England).
TESTING FEASIBILITY OF DETECTING POTENTIAL LOCUST BREEDING SITES Progress Report
D. E. Pedgley, Principal Investigator 27 Apr. 1973 2 p Sponsored by NASA ERTS
(E73-10462; NASA-CR-131528; PR-3) Avail: NTIS HC $3.00 CSCL 06C

There are no author-identified significant results in this report.

N73-21302*# Geological Survey, Washington, D.C. Topographic Div.
OVERALL EVALUATION OF ERTS IMAGERY FOR CARTOGRAPHIC APPLICATION Progress Report, 1 Jan. - 28 Feb. 1973
Alden P. Colvocoresses, Principal Investigator 1 Mar. 1973 5 p ERTS
(NASA Order S-70243-AG-2)
(E73-10463; NASA-CR-131529) Avail: NTIS HC $3.00 CSCL 08B

There are no author-identified significant results in this report.

N73-21303*# TRW Systems Group, Redondo Beach, Calif.
ERTS IMAGE DATA COMPRESSION TECHNIQUE EVALUATION Monthly Progress Report, period ending 1 Apr. 1973
Donald J. Spencer, Principal Investigator 5 Apr. 1973 1 p ERTS
(Contract NAS5-21746)
(E73-10465; NASA-CR-131272) Avail: NTIS HC $3.00 CSCL 05B

There are no author-identified significant results in this report.

N73-21304*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
EVALUATION OF SATELLITE REMOTE SENSING AND AUTOMATIC DATA TECHNIQUES FOR CHARACTERIZATION OF WETLANDS AND MARSHLANDS Progress Report, period ending 28 Feb 1972
Robert H. Cartmill, Principal Investigator 22 Mar. 1973 3 p ERTS
(E73-10467; NASA-TM-X-69128) Avail: NTIS HC $3.00 CSCL 08H

The author has identified the following significant results. Using the 12S Digicol color additive viewer and eight color classification map has been produced of a portion of the study area. Channel 3 of the MSS produced the best map. Enlargements of the MSS data have been accomplished by using the Data Analysis Station. The attached film recorder has three color guns which are capable of placing 2400 square elements across a 9 inch film. It has been found that by repeating ERTS element 9 times and each scan line 13 times that a map of a scale approximately 1:62,000 can be produced as a color negative film strip. This can be contact printed to produce a color map of the scale. As yet this procedure does not correct for image

skew caused by rotation which is believed to be the major source of distortion and blockiness in the image. However, the final product which has not undergone any photographic enlargement is superior to photographically enlarged maps of the same scale.

N73-21305*# Tennessee Univ., Knoxville.
UTILIZATION OF ERTS DATA TO DETECT PLANT DISEASES AND NUTRIENT DEFICIENCIES, SOIL TYPES AND MOISTURE LEVELS Progress Report
W. L. Parks, Principal Investigator, J. I. Sewell, J. W. Hilty, and J. C. Rennie 9 Apr. 1973 17 p Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
(Contract NAS5-21873)
(E73-10468; NASA-CR-131276; PR-1; PR-3) Avail: NTIS HC $3.00 CSCL 20D

The author has identified the following significant results. A significant finding to date is the delineation of the Memphis soil association in Obion County, Dyer County, and in portions of Kentucky. This soil association was delineated mechanically through the use of imagery in the digital tape format, appropriate computer software, and an IBM/360/05 computer. The Waverly-Swamp association as well as the Obion River have been identified on the ERTS-1 imagery as well as on the computer printout. These findings demonstrate the feasibility of delineating major soil associations through vegetative cover common to the association. Channel 7 provides the most information for studies of this type. Computer density printouts assist markedly in making density separations and delineating major soil moisture differences; however, signatures for soil moisture classification for this area of mixed land uses in relatively small tracts have not yet been developed.

N73-21306*# Department of the Environment, Ottawa (Ontario). Applied Hydrology Div.
WATER SURVEY OF CANADA: APPLICATION FOR USE OF ERTS-A FOR RETRANSMISSION OF WATER RESOURCES DATA Progress Report, Jul. - Dec. 1972
R. A. Halliday, Principal Investigator Mar. 1973 10 p Sponsored by NASA ERTS
(E73-10469; NASA-CR-131277) Avail: NTIS CSCL 08H

The author has identified the following significant results. Nine sites in isolated regions in Canada have been selected for installation of ERTS data collection platforms. Seven platforms were installed in 1972, one of which did not operate. The six operating platforms transmitted over 7000 water level readings from stream gauging stations. This data is available on a near real time basis through the Canada Center for Remote Sensing and is used for river flow forecasting. The practicability of using satellite retransmission as a means of obtaining data from remote areas has been demonstrated.

N73-21307*# Michigan State Univ., East Lansing. Agricultural Experiment Station.
USE OF ERTS DATA FOR A MULTIDISCIPLINARY ANALYSIS OF MICHIGAN RESOURCES Progress Report
Axel L. Anderson, Principal Investigator 10 Apr. 1973 17 p ERTS
(Contract NAS5-21834)
(E73-10470; NASA-CR-131278) Avail: NTIS HC $3.00 CSCL 08F

There are no author-identified significant results in this report.

N73-21308*# Kansas Univ./Center for Research, Inc., Lawrence.
VARIATIONS IN THE DETECTABILITY OF MAJOR AIRPORTS IN NORTHEASTERN KANSAS AND NORTHWESTERN MISSOURI
Stanley A. Morain, Principal Investigator, Jerry C. Coiner, and Donald L. Williams 6 Jan. 1973 2 p ERTS
(Contract NAS5-21822)
(E73-10471; NASA-CR-131281) Avail: NTIS HC $3.00 CSCL 01E

The author has identified the following significant results. Six major airports are located within the ERTS-1 imagery. Runways at four of the airports are readily detectable. Runways at the other two airports are not detectable and the locations must be inferred by other means. This variation is attributed to variation in runway surface composition.

N73-21309*# Kansas Univ./Center for Research, Inc., Lawrence.
MONITORING CORN HARVEST PROGRESS FROM ERTS-1, SOUTHERN FINNEY COUNTY, KANSAS
Stanley A. Morain, Principal Investigator and Donald L. Williams 3 Jan. 1973 2 p ERTS
(Contract NAS5-21822)
(E73-10472; NASA-CR-131282) Avail: NTIS HC $3.00 CSCL 02C

The author has identified the following significant results. Comparison of ERTS-1 imagery of three dates reveals that corn harvesting is detectable by observing tonal change associated with the change from photosynthetically active plants to bare ground.

N73-21310*# Nevada Univ., Reno. Mackay School of Mines.
COMPILE TWO PHOTOMAPS OF THE STATE OF NEVADA Progress Report
Joseph Lintz, Jr., Principal Investigator 29 Jan. 1973 3 p ERTS
(Contract NAS5-21864)
(E73-10473; NASA-CR-131298) Avail: NTIS HC $3.00 CSCL 08B

There are no author-identified significant results in this report.

N73-21311*# Kansas Univ./Center for Research, Inc., Lawrence.
LAND USE MAP, FINNEY COUNTY, KANSAS
Stanley A. Morain, Principal Investigator, Donald L. Williams, and Jerry C. Coiner 11 Jan. 1973 8 p refs ERTS
(Contract NAS5-21822)
(E73-10474; NASA-CR-131284) Avail: NTIS HC $3.00 CSCL 08B

The author has identified the following significant results. Methods for the mapping of land use in agricultural regions are developed and applied to preparation of a land use map of Finney County, Kanas. Six land use categories were identified from an MSS-5 image. These categories are: (1) large field irrigation; (2) small field irrigation; (3) dryland cultivation; (4) rangeland; (5) cultural features; and (6) riverine land. The map is composed of basically homogeneous regions with definable mixtures of the six categories. Each region is bounded by an ocularly evident change in land use.

N73-21312*# Kansas Univ./Center for Research, Inc., Lawrence.
DISCRIMINATION OF WINTER WHEAT ON IRRIGATED LAND IN SOUTHERN FINNEY COUNTY, KANSAS
Stanley A. Morain, Principal Investigator, Donald L. Williams, Bonnie Barker, and Jerry C. Coiner 31 Jan. 1973 5 p ERTS
(Contract NAS5-21822)
(E73-10475; NASA-CR-131285) Avail: NTIS HC $3.00 CSCL 02C

The author has identified the following significant results. Winter wheat in the large field irrigated landscape of southern Finney County, Kansas was successfully discriminated by use of 4 ERTS-1 images. These images were acquired 16 August 1972, 21 September 1972, and 2 December 1972. MSS-5 images from each date and the MSS-7 image from 2 December 1972 were used. Human interpretation of the four images resulted in a classification scheme which produced 98% correct estimation of the number of wheat fields in the training sample and 100% correct estimation in the test sample. Overall correct separation of wheat from non-wheat fields was 93% and 86%, respectively. Offsetting errors resulted in the estimation accuracy for wheat.

N73-21313*# Mississippi State Univ., State College.
APPLICATION OF ERTS-A DATA TO AGRICULTURAL PRACTICES IN THE MISSISSIPPI DELTA REGION Interim Report, Nov. 1972 - Mar. 1973
C. W. Bouchillon, F. M. Ingels, Principal Investigators, and R. W. Boyd Apr. 1973 12 p ERTS
(Contract NAS5-21881)
(E73-10476; NASA-CR-131286) Avail: NTIS HC $3.00 CSCL 02C

There are no author-identified significant results in this report.

N73-21314*# Tennessee Univ., Knoxville. Dept. of Electrical Engineering.
ERTS-A IMAGERY INTERPRETATION TECHNIQUES IN THE TENNESSEE VALLEY Semiannual Progress Report
Robert E. Bodenheimer, Principal Investigator 15 Apr. 1973 13 p ERTS
(Contract NAS5-21875)
(E73-10477; NASA-CR-131287) Avail: NTIS HC $3.00 CSCL 08B

There are no author-identified significant results in this report.

N73-21315*# Stanford Univ., Calif. School of Earth Sciences.
STRUCTURAL AND LITHOLOGIC STUDY OF NORTHERN COAST RANGES AND SACRAMENTO VALLEY, CALIFORNIA Progress Report
Ernest I. Rich, Principal Investigator 1 Mar. 1973 4 p ERTS
(Contract NAS5-21775)
(E73-10478; NASA-CR-131283) Avail: NTIS HC $3.00 CSCL 08F

The author has identified the following significant results. Analysis of ERTS-1 imagery of the Northern California Coast Ranges has disclosed a potential relation between a heretofore unrecognized fracture system and known deposits of mercury and geothermally active areas in the Coast Range and between oil and gas fields in the Sacramento Valley. Three potentially important systems of linear elements within the Coast Ranges, detected on ERTS-1 imagery, may represent fault systems or zones of shearing because topographic offset and stratigraph disruption can be seen along one or two of the lineations. One of the systems in subparallel to the San Andreas fault and is confined to the Pacific Coastal Belt. Another set is confined to the central core of the Coast Ranges. The third set of linear features (Valley System) has not heretofore been recognized. Some of the known mercury deposits and geothermally active areas near Clear Lake, in the Coast Ranges, are along the Valley System or at the intersection of the Central and Valley Systems. The plotted locations of some of the oil and gas fields in the Sacramento Valley are associated with the Valley and/or Central Systems. If these relations prove reliable, the ERTS-1 imagery may prove to be an extremely useful exploration tool. A.L.

N73-21316*# Department of the Environment, Ottawa (Ontario).
DATA RETRANSMISSION FROM WATER SURVEY OF CANADA GAUGING STATIONS USING ERTS-1
R. A. Halliday, Principal Investigator 23 Jan. 1973 7 p Presented at Ontario District Conf. of the Water Surv. of Can., Guelph, Ontario, 25 Jan. 1973 Sponsored by NASA ERTS
(E73-10479; NASA-CR-131299) Avail: NTIS HC $3.00 CSCL 08H

There are no author-identified significant results in this report.

N73-21317*# Earth Satellite Corp., Washington, D.C.
INVESTIGATION TO IMPROVE MENHADEN FISHERY PREDICTION Progress Report, 11 Feb. - 10 Apr. 1973
Paul M. Maughan, Principal Investigator 9 Apr. 1973 3 p ERTS
(Contract NAS5-21743)
(E73-10480; NASA-CR-131300) Avail: NTIS HC $3.00 CSCL 08A

There are no author-identified significant results in this report.

N73-21318*# Direccion de Cartografia Nacional, Caracas (Venezuela).
DEVELOPMENT OF TECHNIQUES FOR THE SIMPLIFICATION OF THE INVESTIGATION AND ESTIMATES PROCESS FOR NATURAL RESOURCES IN REMOTE AND RELATIVELY UNEXPLORED AREAS (VENEZUELA) Report for Jun. 1972 - Mar. 1973
Adolfo C. Romero, Principal Investigator Mar. 1973 8 p Sponsored by NASA ERTS
(E73-10481; NASA-CR-131301) Avail: NTIS HC $3.00 CSCL 08F

There are no author-identified significant results in this report.

N73-21319*# Oceanographic Services, Inc., Santa Barbara, Calif.
PROGRESS ON THE ACQUISITION AND ANALYSIS OF COASTAL GROUND TRUTH DATA FOR CORRELATION WITH ERTS-1 DATA Progress Report, 2 Oct. 1972 - 2 Apr. 1973
William A. Anikouchine, Principal Investigator 1 Apr. 1973 17 p ERTS
(Contract NAS5-21877)
(E73-10482; NASA-CR-131302) Avail: NTIS HC $3.00 CSCL 08B

There are no author-identified significant results in this report.

N73-21320*# Environmental Research Inst. of Michigan, Ann Arbor.
USE OF ERTS DATA FOR A MULTIDISCIPLINARY ANALYSIS OF MICHIGAN RESOURCES Progress Report, 1 Feb. - 21 Mar. 1973
Axel L. Anderson, Principal Investigator 3 Apr. 1973 11 p ref ERTS
(Contract NAS5-21834)
(E73-10483; NASA-CR-131303) Avail: NTIS HC $3.00 CSCL 08F

There are no author-identified significant results in this report.

N73-21321*# Corps of Engineers, Champaign, Ill.
EFFECTS OF CONSTRUCTION AND STAGED FILLING OF RESERVOIRS ON THE ENVIRONMENT AND ECOLOGY Progress Report, 8 Feb. - 8 Apr. 1973
Ravinder K. Jain, Principal Investigator 8 Apr. 1973 2 p ERTS
(NASA Order S-70255-AG)
(E73-10484; NASA-CR-131304) Avail: NTIS HC $3.00 CSCL 08H

There are no author-identified significant results in this report.

N73-21322*# National Environmental Satellite Service, Washington, D.C.
EVALUATION OF ERTS DATA FOR CERTAIN HYDROLOGICAL USES Progress Report, Feb. - Mar. 1973
Donald R. Wiesnet and David F. McGinnis, Principal Investigators Mar. 1973 4 p ERTS
(NASA Order S-70246-AG)
(E73-10485; NASA-CR-131305) Avail: NTIS HC $3.00 CSCL 08H

There are no author-identified significant results in this report.

N73-21323*# Geological Survey, Menlo Park, Calif.
PRINCIPAL SOURCES AND DISPERSAL PATTERNS OF SUSPENDED PARTICULATE MATTER IN NEARSHORE SURFACE WATERS OF THE NORTHEAST PACIFIC OCEAN AND THE HAWAIIAN ISLANDS Progress Report, 1 Sep. 1972 - 1 Mar. 1972
Paul R. Carlson, Principal Investigator, T. John Conomos, Richard J. Janda, and David H. Peterson 2 Apr. 1973 9 p ERTS
(NASA Order S-70243-AG-7)
(E73-10487; NASA-CR-131307) Avail: NTIS HC $3.00 CSCL 08C

The author has identified the following significant results. ERTS-1 multispectral scanner imagery of the nearshore surface waters of the Northeast Pacific Ocean is proving to be a useful tool for determining source and dispersal of suspended particulate matter. The principal sources of the turbid water, seen best on the green and red bands, are river and stream effluents and actively eroding coastlines; secondary sources are waste effluents and production of planktonic organisms, but these may sometimes be masked by the very turbid plumes of suspended sediment being discharged into the nearshore zone during times of high river discharge. The configuration and distribution of the plumes of turbid water also can be used to infer near-surface current directions. Comparison of imagery of the nearshore water off the northern California coast from October 1972 and January 1973 shows a reversal of the near-surface currents, from predominantly south-setting in the fall (California Current) to north-setting in the winter (Davidson Current).

N73-21324*# American Univ., Washington, D.C.
A PRELIMINARY EVALUATION OF DRY SEASON/DROUGHT STATUS IN THE SAHELIAN ZONE OF MALI, MAURITANIA AND SENEGAL, BASED ON ERTS-1 IMAGERY
Norman H. MacLeod, Principal Investigator, Priscilla Reining (Catholic Univ. of Am.), and Jane Schubert 23 Apr. 1973 5 p refs ERTS

(Contract NAS5-21892)
(E73-10488; NASA-CR-131308) Avail: NTIS HC $3.00 CSCL 08M

There are no author-identified significant results in this report.

N73-21325*# Bureau of Reclamation, Denver, Colo.
MONITOR WEATHER CONDITIONS FOR CLOUD SEEDING CONTROL Progress Report, 1 Jan. - 1 Apr. 1973
Archie M. Kahan, Principal Investigator 2 Apr. 1973 3 p ERTS
(NASA Order S-70243-AG-8)
(E73-10489; NASA-CR-131309) Avail: NTIS HC $3.00 CSCL 04B

There are no author-identified significant results in this report.

N73-21326*# Geological Survey, Washington, D.C.
CENSUS CITIES EXPERIMENT IN URBAN CHANGE DETECTION Progress Report, 31 Jan. - 28 Feb. 1973
James R. Wray, Principal Investigator 1 Mar. 1973 6 p ERTS
(NASA Order S-70243-AG-2)
(E73-10490; NASA-CR-131310) Avail: NTIS HC $3.00 CSCL 08B

The author has identified the following significant results. Computer compatible tapes for an early ERTS-1 multispectral scanner image over the San Francisco Bay area are being used to classify and analyze land use in this metropolitan region. NASA aircraft underflight data and land use maps from the Census Cities ERTS-1 experiment are providing training samples. The tape record has been reformatted for use with the LARSYSSA pattern recognition and classification algorithms developed at the Purdue University Laboratory for Applications of Remote Sensing. Trial land use classification systems are being compared with color infrared photography and ground truth data for San Jose and vicinity.

N73-21327*# Geological Survey, Miami, Fla.
DEVELOPING A DATA RELAY NETWORK FOR MONITORING HYDROLOGIC CONDITIONS IN SOUTH AND CENTRAL FLORIDA Progress Report, 1 Dec. 1972 - 1 Feb. 1973
A. L. Higer, Principal Investigator, E. T. Wimberly, and E. H. Cordes 2 Feb. 1973 9 p Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
(NASA Order S-70243-AG-7)
(E73-10491; NASA-CR-131311) Avail: NTIS HC $3.00 CSCL 08H

There are no author-identified significant results in this report.

N73-21328*# Geological Survey, Menlo Park, Calif.
STUDIES OF THE INNER SHELF AND COASTAL SEDIMENTATION ENVIRONMENT OF THE BEAUFORT SEA FROM ERTS-1 Progress Report, 1 Jan. - 1 Mar. 1973
Erk Reimnitz, Principal Investigator and Peter W. Barnes 30 Mar. 1973 7 p refs ERTS
(NASA Order S-70243-AG)
(E73-10492; NASA-CR-131312) Avail: NTIS HC $3.00 CSCL 08C

The author has identified the following significant results. Northward flowing rivers of Alaska inundate extensive areas of sea ice during spring breakup. This process has been studied under the ERTS-1 program. Drainage of large volumes of fresh water through the ice at holes and cracks (strudel) causes scour depressions, over 4 m deep, and up to 20 m across in the sea floor below. Strudel scours occur within 30 km of river mouths, generally in areas where ERTS-1 imagery shows less potential for drifting ice to scour the bottom than elsewhere. The shapes and distribution patterns of strudel scours correspond with those of strudel seen in the ice canopy. Densities of scours are highest in the inner areas of overlfow. But strudel scours also occur outside of overflow areas mapped during the last several years. These must be very old. One strudel scour investigated by diving is surrounded by a rim, has vertical walls exposing a tundra horizon, and terminates at a gravel layer 4 m below the lagoon floor. Another terminates at a semi-consolidated layer of silty clay. The gravel and silty clay are pre-Holocene deposits. Mixing of Holocene marine with older sediments by vertical strudel flow causes great variability in sediment types over small areas. These observations complicate interpretation of shallow water deposits of cold climates.

N73-21329*# Geological Survey, Arlington, Va.
DYNAMICS OF SUSPENDED SEDIMENT PLUMES IN LAKE ONTARIO Progress Report, 1 Jan. - 28 Feb. 1973
Edward J. Pluhowski, Principal Investigator 1 Mar. 1973 3 p ERTS
(NASA Order S-70243-AG-2)
(E73-10493; NASA-CR-131313) Avail: NTIS HC $3.00 CSCL 08H

The author has identified the following significant results. Owing to the normally heavy cloud cover over the lake during the winter, just one ERTS-1 frame was received during the report period. This imagery, obtained January 29, 1973 shows that the highly turbid waters from the Welland Canal and Port Dalhousie harbor commonly seen during the shipping season were not in evidence. Instead, only a broad band of slightly turbid waters extending about 2 to 3 miles into the lake is visible from just west of Port Dalhousie to the Niagara River outlet. A broad band of altocumulus clouds east of the Niagara River precluded study of nearly all of the New York shoreline.

N73-21330*# Geological Survey, Harrisburg, Pa.
PERFORMANCE OF THE ERTS DATA COLLECTION SYSTEM IN A TOTAL SYSTEM CONTEXT Progress Report, 1 Jan. - 28 Feb. 1973
Richard W. Paulson, Principal Investigator 21 Mar. 1973 3 p ERTS
(NASA Order S-70243-AG)
(E73-10494; NASA-CR-131314) Avail: NTIS HC $3.00 CSCL 05B

The author has identified the following significant results. Approximately 70 percent of the DCP's being installed by Department of the Interior investigators have been successfully operated. These include DCP's operating in Iceland, Central America, Hawaii, and the Continental United States. The Data Collection System specifications are being met for frequency of data collection.

N73-21331*# Geological Survey, Menlo Park, Calif.
REMOTE SENSING OF PERMAFROST AND GEOLOGICAL HAZARDS IN ALASKA Progress Report, 1 Jan. - 28 Feb. 1973
Oscar J. Ferrians, Jr., Principal Investigator 1 Mar. 1973 3 p ERTS
(NASA Order S-70243-AG-2)
(E73-10495; NASA-CR-131315) Avail: NTIS HC $3.00 CSCL 08G

The author has identified the following significant results. The study of the ERTS-1 imagery of Alaska indicates the following: that areas of different topographic expression affecting the distribution and character of permafrost can be distinguished clearly; that on the Arctic North Slope, regional differences in the distribution and character of permafrost-related oriented thaw lakes can be observed; that the distribution of certain types of geologic materials having a significant effect on the character of permafrost can be delineated on a regional scale; and that the resolution of the imagery is adequate to identify large scale geologic hazards such as landslides, glacier-dammed lakes, aufeis fields, etc. The information concerning the distribution and character of permafrost and geologic hazards to be gained in accomplishing the objectives of this project will be an invaluable aid in solving engineering-geologic and environmental problems related to route and site selection for structures such as roads, railroads, pipelines, and large installations; to distribution of natural construction materials; and to construction and maintenance.

N73-21332*# Geological Survey, Menlo Park, Calif.
IDENTIFICATION OF GEOSTRUCTURES OF CONTINENTAL CRUST PARTICULARLY AS THEY RELATE TO MINERAL RESOURCE EVALUATION Progress Report, 1 Jan. - 28 Feb. 1973
George Gryc, Principal Investigator and Ernest H. Lathram 1 Apr. 1973 5 p refs ERTS
(NASA Order S-70243-AG-1)
(E73-10496; NASA-CR-131316) Avail: NTIS HC $3.00 CSCL 08G

There are no author-identified significant results in this report.

N73-21333*# Geological Survey, Washington, D.C.
CENTRAL ATLANTIC REGIONAL ECOLOGICAL TEST SITE: A PROTOTYPE REGIONAL ENVIRONMENTAL INFORMATION SYSTEM Progress Report, 1 Jan. - 28 Feb. 1973
Robert H. Alexander, Principal Investigator 1 Mar. 1973 16 p ERTS
(NASA Order S-70243-AG-3)
(E73-10497; NASA-CR-131317) Avail: NTIS HC $3.00 CSCL 06F

The author has identified the following significant results. A comparison of photomorphic regions from an uncontrolled ERTS-1 mosaic of CARETS to land use areas on a map published in the National Atlas revealed close correlations in non-urban regions. Such regional scale analysis of ERTS-1 data has the potential for providing an economical sampling strategy for selecting sites for more detailed field measurements if other environmental variables can be correlated with patterns on ERTS-1 imagery. ERTS-1 imagery has also revealed for the first time the appearance of CARETS during the winter months. Investigators have identified extensive areas of conifers, which have previously been indistinguishable from deciduous vegetation. Imagery has also shown very clearly the extent of snow cover at a particular time over the region. The evaluation of ERTS-1 imagery used for the land use mapping of the shore zone of CARETS, has shown that the presence or absence of elements of an hierarchal system of shoreline landforms can help identify areas of potential rapid change. Changes in land use class distributions on the Barrier Islands signify the environmental response to natural and man-caused processes. Both environmental vulnerability and sensitivity can be estimated from the repetitive ERTS-1 coverage of long reaches of the CARETS coast. Results indicate potential applications to land use planning, management, and regional environmental quality analysis.

N73-21334*# Cornell Univ., Ithaca, N.Y. Div. of Atmospheric Sciences.
PHENOLOGY SATELLITE EXPERIMENT Progress Report, Aug. 1972 - Feb. 1973
Bernard E. Dethier, Principal Investigator 16 Apr. 1973 48 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
(Contract NAS5-21781)
(E73-10498; NASA-CR-131318) Avail: NTIS HC $4.50 CSCL 02C

The author has identified the following significant results. The detection of a phenological event (the Brown Wave-vegetation sensescence) for specific forest and crop types using ERTS-1 imagery is described. Data handling techniques including computer analysis and photointerpretation procedures are explained. Computer analysis of multspectral scanner digital tapes in all bands was used to give the relative changes of spectral reflectance with time of forests and specified crops. These data were obtained for a number of the twenty-four sites located within four north-south corridors across the United States. Analysis of ground observation photography and ERTS-1 imagery for sites in the Appalachian Corridor and Mississippi Valley Corridor indicates that the recession of vegetation development can be detected very well. Tentative conclusions are that specific phenological events such as crop maturity or leaf fall can be mapped for specific sites and possible for different regions. Preliminary analysis based on a number of samples in mixed deciduous hardwood stands indicates that as senescence proceeds both the rate of change and differences in color among species can be detected. The results to data show the feasibility of the development and refinement of phenoclimatic models.

N73-21335*# Aerospace Corp., Los Angeles, Calif.
STUDY TO DEMONSTRATE THE FEASIBILITY OF AND DETERMINE THE OPTIMUM METHOD OF REMOTE HAZE MONITORING BY SATELLITE Progress Report, 1 Dec. 1972 - 31 Jan. 1973
Ernest H. Rogers, Principal Investigator 31 Jan. 1973 7 p Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
(Contract NAS5-21719)
(E73-10499; NASA-CR-131466) Avail: NTIS HC $3.00 CSCL 04B

There are no author-identified significant results in this report.

N73-21336*# Geological Survey, Washington, D.C. Topographic Div.
INVESTIGATION OF ERTS-1 IMAGES FOR APPLICATION TO THEMATIC MAPPING Progress Report, 1 Jan. - 28 Feb. 1973
Doyle Smith 1 Mar. 1973 3 p ERTS
(NASA Order S-70243-AG)
(E73-10500; NASA-CR-131530) Avail: NTIS HC $3.00 CSCL 08B

The author has identified the following significant results. Theme extractions from high quality 1:1,000,000-scale enlargements carry an encouraging amount of fine detail.

N73-21337*# Geological Survey, Washington, D.C.
THE CARTOGRAPHIC APPLICATION OF ERTS/RBV IMAGERY IN POLAR REGIONS Progress Report, 1 Jan. - 28 Feb. 1973
William R. MacDonald, Principal Investigator 1 Mar. 1973 4 p ERTS
(NASA Order S-70243-AG-2)
(E73-10501; NASA-CR-131536) Avail: NTIS HC $3.00 CSCL 08B

There are no author-identified significant results in this report.

N73-21338*# Geological Survey, Washington, D.C. Topographic Div.
INVESTIGATION OF ERTS/RBV IMAGERY FOR PHOTOMAPPING OF THE UNITED STATES Progress Report, 1 Jan. - 28 Feb. 1973
Joseph T. Pilonero, Principal Investigator 1 Mar. 1973 2 p ERTS
(NASA Order S-70243-AG)
(E73-10502; NASA-CR-131537) Avail: NTIS HC $3.00 CSCL 08B

There are no author-identified significant results in this report.

N73-21339*# Ohio State Univ. Research Foundation, Columbus.
REFRACTION EFFECTS OF ATMOSPHERE ON GEODETIC MEASUREMENTS TO CELESTIAL BODIES
C. S. Joshi Jan. 1973 101 p refs
(Grant NGR-36-008-093)
(NASA-CR-131534; Rept-192) Avail: NTIS HC $7.25 CSCL 03A

The problem is considered of obtaining accurate values of refraction corrections for geodetic measurements of celestial bodies. The basic principles of optics governing the phenomenon of refraction are defined, and differential equations are derived for the refraction corrections. The corrections fall into two main categories: (1) refraction effects due to change in the direction of propagation, and (2) refraction effects mainly due to change in the velocity of propagation. The various assumptions made by earlier investigators are reviewed along with the basic principles of improved models designed by investigators of the twentieth century. The accuracy problem for various quantities is discussed, and the conclusions and recommendations are summarized.
D.L.G.

N73-21340*# California Inst. of Tech., Pasadena.
GRAVITATIONAL-WAVE OBSERVATIONS AS A TOOL FOR TESTING RELATIVISTIC GRAVITY
Douglas M. Eardley, David L. Lee, Alan P. Lightman, Robert V. Wagoner (Cornell Univ., Ithaca, N. Y.), and Clifford M. Will (Chicago Univ., Ill.) [1973] 9 p refs
(Grants NGR-05-002-256; NSF GP-36687X; NSF GP-28027; NSF GP-26068; NSF GP-34721X)
(NASA-CR-131511) Avail: NTIS HC $3.00 CSCL 08N

Approaches regarding the role of gravitational wave observations in the investigation of relativistic theories of gravity are treated as providing greater potential in the prediction of wave propagation speed and the polarization properties of gravitational waves. The invariant classes of waves discussed have the same post-Newtonian limit as general relativity for a reasonable choice of cosmological models.
J.M.M.

N73-21341*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
A SUPPLEMENTAL CATALOG OF ATMOSPHERIC DENSITIES FROM SATELLITE-DRAG ANALYSIS
Luigi G. Jacchia and Jack W. Slowey 28 Dec. 1972 329 p refs
(Grant NGR-09-015-002)
(NASA-CR-131646; SAO-Special-Rept-348) Avail: NTIS HC $18.50 CSCL 04A

The catalog of densities derived from satellite-drag analysis extends and supplements similar earlier publications. The densities were computed from nine artificial satellites for effective heights ranging from 300 to 1130 km, and are presented together with pertinent data that permit the location in time and space of the point to which they refer. The intervals covered vary between 1 and 6 years for the different satellites and average about 3.5 years for the nine satellites. The cutoff date for the data included is, in most cases, January 14, 1970. Author

N73-21342*# Pennsylvania State Univ., University Park. Ionosphere Research Lab.
PROPAGATION STUDIES USING A THEORETICAL IONOSPHERE MODEL
Myung-Ki Lee 1 Mar. 1973 150 p refs
(Grants NGL-39-009-003; NGR-39-009-002; Contract N00014-67-A-0385-0017; Grant NSF GA-27758)
(NASA-CR-131547; PSU-IRL-SCI-408) Avail: NTIS HC $9.50 CSCL 04A

The mid-latitude ionospheric and neutral atmospheric models are coupled with an advanced three dimensional ray tracing program to see what success would be obtained in predicting the wave propagation conditions and to study to what extent the use of theoretical ionospheric models is practical. The Penn State MK 1 ionospheric model, the Mitra-Rowe D region model, and the Groves' neutral atmospheric model are used throughout this work to represent the real electron densities and collision frequencies. The Faraday rotation and differential Doppler velocities from satellites, the propagation modes for long distance high frequency propagation, the group delays for each mode, the ionospheric absorption, and the spatial loss are all predicted. Author

N73-21343# Kyoto Univ. (Japan). Research Inst. for Fundamental Physics.
NEW SERIES OF EXACT SOLUTIONS FOR GRAVITATIONAL FIELDS OF SPINNING MASSES
Akira Tomimatsu and Humitaka Sato Feb. 1973 32 p refs
(RIFP-173) Avail: NTIS HC $3.75

Solutions for space-times which are regarded as representing the gravitational fields of spinning bound masses are derived from a series of Weyl metrics following Ernst's formulation on the axisymmetric stationary fields. This series of solutions includes the Kerr metric as a member of the most simple one. Except the case of the Kerr metric, the space-times have ring singularities outside event horizons, that is, there exist naked singularities. Therefore, these solutions seem to give a very different picture concerning the ultimate fate of gravitational collapse compared with such a current picture as the Israel-Carter conjecture. Author

N73-21344# Kakioka Magnetic Observatory (Japan).
GEOELECTRIC OBSERVATIONS AT KAKIOKA, MEMAMBETSU AND KANOYA IN JAPAN IN 1971
1972 53 p refs
(Rept-89) Avail: NTIS HC $4.75

Tabulated results of geoelectric observations made at three locations in Japan are presented. Hourly values and diurnal variations of atmospheric electric potential gradients are included, as well as notes on pertinent meteorological data for comparable periods. J.M.M.

N73-21345# Kakioka Magnetic Observatory (Japan).
GEOMAGNETIC OBSERVATIONS AR KAKIOKA, JAPAN IN 1971
1972 115 p refs
(Rept-86) Avail: NTIS HC $7.75

Results of geomagnetic observations carried out by the Kakioka Magnetic Observatory are presented in tabular form. Data cover character of the magnetic disturbances, hourly values and associated mean values, and absolute values of magnetic elements. E.H.W.

N73-21346# Kakioka Magnetic Observatory (Japan).
GEOMAGNETIC OBSERVATIONS OF KANOYA, JAPAN IN 1971
1972 120 p refs
(Rept-88) Avail: NTIS HC $8.00

Results of geomagnetic observations carried out by the Kanoya Magnetic Observatory are presented in tabular form. Data cover character of the magnetic disturbances, hourly values and associated mean values, and absolute values of magnetic elements. E.H.W.

N73-21347*# California Univ., Berkeley. Space Sciences Lab.
AN INTEGRATED STUDY OF EARTH RESOURCES IN THE STATE OF CALIFORNIA USING REMOTE SENSING TECHNIQUES Progress Report
Robert N. Colwell 1 Feb. 1971 195 p refs Original contains color illustrations
(Grant NGL-05-003-404)
(NASA-CR-131392) Avail: NTIS HC $11.75 CSCL 08F

Remote sensing techniques are proposed for the management of water resources and land use in California. The impact of the California Water Project is emphasized. For individual titles, see N73-21348 through N73-21357.

N73-21348* California Univ., Berkeley.
INTRODUCTION
Robert N. Colwell *In its* An Integrated Study of Earth Resources in the State of Calif. Using Remote Sensing Tech. 1 Feb. 1971 8 p (For availability see N73-21347 12-13)
CSCL 08F

Management of earth resources requires accurate knowledge of inventories. Developments of improved remote sensing devices and vehicles for their transport, and automatic data processing equipment and techniques are important management tools for an integrated earth resources survey in California. G.G.

N73-21349* California Univ., Berkeley. Social Sciences Group.
DEFINITION OF EARTH RESOURCE POLICY AND MANAGEMENT PROBLEMS IN CALIFORNIA
C. West Churchman and Ibrohim Clark *In its* An Integrated Study of Earth Resources in the State of Calif. Using Remote Sensing Tech. 1 Feb. 1971 10 p (For availability see N73-21347 12-13)
CSCL 05A

Management planning for the California water survey considers the use of satellite and airplane remote sensing information on water-source, -center, and -sink geographies. A model is developed for estimating the social benefit of water resource information and to identify the most important types of resource information relevant to regulatory agencies and the private sector. G.G.

N73-21350* California Univ., Davis. Dept. of Water Science and Engineering.
DEFINITION OF THE INFORMATIONAL REQUIREMENTS OF HYDROLOGIC RESOURCE MANAGERS
Robert H. Burgy and David R. Storm *In its* An Integrated Study of Earth Resources in the State of Calif. Using Remote Sensing Tech. 1 Feb. 1971 8 p (For availability see N73-21347 12-13)
CSCL 08H

The objectives of the integrated study are; (1) to delineate the parameters involved in hydrologic systems; (2) to outline the conventional means used in acquiring information relative to those parameters; and (3) to consider the potential usefulness of modern remote sensing techniques for acquiring certain parts of this information. Author

N73-21351* California Univ., Berkeley. Forestry Remote Sensing Lab.
MEASUREMENT OF HYDROLOGIC RESOURCE PARAMETERS THROUGH REMOTE SENSING IN THE FEATHER RIVER HEADWATERS AREA
Gene A. Thorley, William Draeger, Donald Lauer, Jerry Lent,

and Edwin Roberts *In its* An Integrated Study of Earth Resources in the State of Calif. Using Remote Sensing Tech. 1 Feb. 1971 4 p Original contains color illustrations (For availability see N73-21347 12-13)
CSCL 08H

The four problem areas being investigated are: (1) determination of the feasibility of providing the resource manager with operationally useful information through the use of remote sensing techniques; (2) definition of the spectral characteristics of earth resources and the optimum procedures for calibrating tone and color characteristics of multispectral imagery (3) determination of the extent to which humans can extract useful earth resource information through remote sensing imagery; (4) determination of the extent to which automatic classification and data processing can extract useful information from remote sensing data. Author

N73-21352* California Univ., Los Angeles. Inst. of Geophysics and Planetary Physics.
RIVER MEANDER STUDIES
Gerald Schubert and Richard Lingenfelter *In its* An Integrated Study of Earth Resources in the State of Calif. Using Remote Sensing Tech. 1 Feb. 1971 6 p (For availability see N73-21347 12-13)
CSCL 08E

The feasibility of using satellite television photography of geomorphological indices to obtain a correlation between a stream meander power spectrum and stream discharge frequency distribution is considered. Water resources assessment includes information on the average rainfall over large drainage basins and calculations relating flow measurements to geographical areas. Photoelectric optical scanning techniques provide a digitized procedure for locating and following river meander curve points. G.G.

N73-21353* California Univ., Santa Barbara. Dept. of Geography.
ASSESSMENT OF THE IMPACT OF THE CALIFORNIA WATER PROJECT IN THE WEST SIDE OF THE SAN JOAQUIN VALLEY
John E. Estes, Michael Kuhn, Berl Golomb, Leslie W. Senger, Lyndon Wester, Patrick Fortune, and James Viellenave *In its* An Integrated Study of Earth Resources in the State of Calif. Using Remote Sensing Tech. 1 Feb. 1971 30 p refs Original contains color illustrations (For availability see N73-21347 12-13)
CSCL 08H

The ability of remote sensing techniques to effectively monitor, on a continuing basis, the impact of a change in the water supply of an arid area is considered. Research involves the collection of a substantial body of information relative to both physical and biological phenomena or systems operative within the study area by concentrating on the accumulation of library materials, and field data. Author

N73-21354* California Univ., Riverside. Dept. of Geography.
ASSESSMENT OF THE IMPACT OF THE CALIFORNIA WATER PROJECT IN SOUTHERN CALIFORNIA
Leonard W. Bowden, W. G. Brooner, H. P. Bailey, V. B. Coleman, P. T. Dykman, C. W. Johnson, and R. W. Pease *In its* An Integrated Study of Earth Resources in the State of Calif. Using Remote Sensing Tech. 1 Feb. 1971 35 p (For availability see N73-21347 12-13)
CSCL 08H

As the California State Water Project progresses and enters operation, it is suggested that changes in land use which may be monitored and anlayzed by remote sensing techniques will follow suite. Progress in each of these areas of research and automated mapping techniques to monitor these changes is presented for two specific regions: (1) the Perris Valley surrounding the future Lake Perris; and (2) the Sheep Creek Fan-Mirage Basin area of the Mojave Desert. Author

N73-21355* California Univ., Davis. Dept. of Electrical Engineering and Computer Sciences.
DIGITAL HANDLING AND PROCESSING OF REMOTE SENSING DATA
R. Algazi and D. Sakrison *In its* An Integrated Study of Earth Resources in the State of Calif. Using Remote Sensing Tech. 1 Feb. 1971 18 p refs Sponsored in part by AEC (For availability see N73-21347 12-13)
(Grant NGL-05-003-404)
CSCL 05B

Progress is reported on the development of a computing facility that provides automatic processing of remote sensing data on earth resources. Preliminary work on digital signal processing algorithms and the writing of corresponding programs for the design of digital filters is outlined. G.G.

N73-21356* California Univ., Davis. Dept. of Agricultural Engineering.
INVESTIGATION OF ATMOSPHERIC EFFECTS IN IMAGE TRANSFER **c20**
K. L. Coulson and R. L. Walraven *In its* An Integrated Study of Earth Resources in the State of Calif. Using Remote Sensing Tech. 1 Feb. 1971 11 p Original contains color illustrations (For availability see N73-21347 12-13)
CSCL 04B

Several computations on radiation emerging from the atmosphere for different aerosol models have been performed and the reflection matrix of a given surface was defined by incident light signature analyses. A two channel polarimeter is being constructed for measuring the Stokes parameters of reflected light. Surface albedo measurements were made in six wavelength ranges in the ultraviolet, visible, and near infrared spectral regions for six different vegetated surfaces, four soil surfaces, and two roadway surfaces. The effects of polarization changes on the intensity of projected images were studied by using a rotatable polarizer in front of an aerial camera lens. G.G.

N73-21357* California Univ., Berkeley.
COASTAL ZONE AND RIVER DELTA STUDIES
In its An Integrated Study of Earth Resources in the State of Calif. Using Remote Sensing Tech. 1 Feb. 1971 18 p (For availability see N73-21347 12-13)
CSCL 08H

Remote sensing techniques are proposed for the development of a California coastal land use classification system which depicts and reflects essential parameters of environmental conditions and quality. Included in the earth resources survey is the Sacramento-San Joaquin River Delta and its complex hydrologic system which links saline waters of the San Francisco Bay with the Central Valley watershed. G.G.

N73-21358# Kakioka Magnetic Observatory (Japan).
GEOMAGNETIC OBSERVATIONS AT MEMAMBETSU, JAPAN IN 1971
1972 120 p refs
(Rept-87) Avail: NTIS HC $8.00

Results of geomagnetic observations carried out by Memambetsu Magnetic Observatory are presented in tabular form. Data cover character of the magnetic disturbances, hourly values and associated mean values, and absolute values of magnetic elements. E.H.W.

N73-21359# Environmental Data Service, Asheville, N.C.
INTERNATIONAL DECADE OF OCEAN EXPLORATION Progress Report, Jan. 1970 - Jul. 1972
Jan. 1973 38 p refs Sponsored by NSF
Avail: NTIS HC $4.00

Information, data inventories, and lists of scientific reports pertaining to the international decade of ocean exploration are presented. The text is arranged according to the program areas and details on subprograms or projects are given under appropriate headings. A computerized summary of reported observations made at sea during the period of the report is included. A chart showing ocean areas for which data and track information are developed is submitted. Author

N73-21360*# Arizona Univ., Tucson. Office of Arid Land Studies.
RESEARCH FOR APPLICATIONS OF REMOTE SENSING TO STATE AND LOCAL GOVERNMENTS (ARSIG) Annual Report
Kennith E. Foster and Jack D. Johnson Feb. 1973 199 p refs
(Grant NGL-03-002-313)
(NASA-CR-131643; OALS-Bull-5) Avail: NTIS HC $12.00 CSCL 08E

Remote sensing and its application to problems confronted by local and state planners are reported. The added dimension of remote sensing as a data gathering tool has been explored identifying pertinent land use factors associated with urban growth such as soil associations, soil capability, vegetation distribution, and flood prone areas. Remote sensing within rural agricultural setting has also been utilized to determine irrigation runoff volumes, cropping patterns, and land use. A variety of data sources including U-2 70 mm multispectral black and white photography, RB-57 9-inch color IR, HyAC panoramic color IR and ERTS-1 imagery have been used over selected areas of Arizona including Tucson, Arizona (NASA Test Site #30) and the Sulphur Springs Valley. Author

N73-21361*# South Dakota State Univ., Brookings. Remote Sensing Inst.
MONITORING FLOOD DAMAGE WITH SATELLITE IMAGERY Interim Report
L. A. Benson and F. A. Waltz Mar. 1973 15 p refs
(Grant NGL-42-003-007)
(NASA-CR-131641; SDSU-RSI-73-07) Avail: NTIS HC $3.00 CSCL 08H

During analysis of ERTS-1 imagery for land use patterns a large impoundment of water was observed in a location that was normally farmland. Subsequent investigation revealed that the satellite had recorded the remaining floodwaters from a severe local rainstorm that had occurred four days prior to the overpass. The inundated area was measured using the automatic planimeter associated with the signal analysis and dissemination equipment located at the Remote Sensing Institute. The area measurement coupled with estimates of the land use and productivity of the region permitted an estimate of the crop damage loss for the inundated area. Author

N73-21362# Kiruna Geophysical Observatory (Sweden).
KIRUNA GEOPHYSICAL DATA Data Summary, Jul. - Sep. 1972
L. Liszka, ed. Sep. 1972 65 p
(Data-Summary-72/7-9) Avail: NTIS HC $5.25

Results of ground-based continuous measurements of upper atmosphere variables carried out at Kiruna Geophysical Observatory are presented. Current data related to polar upper atmosphere condition is included. Ionosonde data, neutron monitor data, and auroral plots are also considered. Author

N73-21363# Joint Publications Research Service, Arlington, Va.
UNITED STATES' FORECASTS FOR THE STUDY AND EXPLORATION OF THE WORLD OCEAN
V. D. Pisarev 10 Apr. 1973 14 p refs Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. V: Geograf (Moscow), Jan. - Feb. 1973 p 19-27
(JPRS-58696) Avail: NTIS HC $3.00

The possible use of scientific, industrial, and military equipment to broaden the possibilities of oceanological investigations is discussed. The use of such equipment for exploitation of resources, strategic areas, and ocean floors and depths is also covered. Author

N73-21364*# Northrop Services, Inc., Huntsville, Ala.
SPECIFICATION OF MESOSPHERIC DENSITY, PRESSURE, AND TEMPERATURE BY EXTRAPOLATION
M. E. Graves, Y. S. Low, and A. H. Miller Washington NASA Mar. 1973 105 p refs
(Contract NAS8-21810)
(NASA-CR-2223; M113) Avail: NTIS HC $3.00 CSCL 04A

A procedure is presented which employs an extrapolation technique to obtain estimates of density, pressure, and temperature up to 90 km from 52 km data. The resulting errors are investigated. The procedure is combined with a special temperature interpolation method around the stratopause to produce such estimates at eight levels between 36 km and 90 km from North American sectional chart data at 5, 2, and 0.4 mb. Fifth charts were processed to obtain mean values and standard deviations at grid points for midseasonal months from 1964 to 1966. The mean values were compared with Groves' model, and internal consistency tests were performed upon the statistics. Through application of the extrapolation procedure, the atmospheric structure of a stratospheric warming event is studied. Author

N73-21365# Lockheed Missiles and Space Co., Palo Alto, Calif.
OSCILLATIONS OF THE MAGNETIC TAIL OF THE EARTH
A. I. Ershkovich and A. A. Nusinov [1972] 6 p refs Transl. into ENGLISH from the book "Mezhplanetnaia Sreda i Fizika Magnitosfery" Nauka, Moscow, 1972 p 191-195
Avail: NTIS HC $3.00; National Translations Center, John Crerar Library, Chicago, Ill. 60616

The excitation mechanism of natural geomagnetic tail oscillations was investigated while both solar wind parameters and the character of natural oscillations underwent change. A model of the tail as a plasma cylinder with free boundaries was examined under frozen magnetic field conditions of perfect conduction and incompressibility. Then a linearized system of magnetohydrodynamic equations for perturbation and energy was formulated and used for the calculation of the store of magnetic energy in the tail which can be sufficient to produce a magnetic storm of several hundred gammas. J.M.M.

N73-21366# Joint Publications Research Service, Arlington, Va.
BASIC PROBLEMS IN SOVIET MARINE GEOLOGICAL EXPLORATION
V. I. Igrevskiy, N. P. Budnikov, and V. A. Levchenko 6 Apr. 1973 25 p ref Transl. into ENGLISH from Sov. Geol. (Moscow), no. 11, Nov. 1972 p 9-24
(JPRS-58668) Avail: NTIS HC $3.25

A perspective is provided on the necessity of off-shore and deep ocean drilling for oil and mineral deposits, as well as on the geological obstacles involved. Recommendations are included for the location (gravimetric surveying, and electrical and seismic prospecting) and extraction methods for the recovery of the large ocean bottom deposits of petroleum, metal ores, and natural gases. J.M.M.

N73-21367*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SIMULTANEOUS PARTICLE AND FIELD OBSERVATIONS OF FIELD-ALIGNED CURRENTS
Frederick W. Berko, Robert A. Hoffman, Rande K. Burton (Calif. Univ., Los Angeles), and Robert E. Holzer (Calif. Univ., Los Angeles) Apr. 1973 34 p refs Submitted for publication
(NASA-TM-X-66224; X-646-73-45) Avail: NTIS HC $3.75 CSCL 08N

Simultaneous measurements of low energy precipitating electrons and magnetic fluctuations from the low altitude polar orbiting satellite OGO-4 have been compared. Analysis of the two sets of experimental data for isolated events led to the classification of high latitude field-aligned currents as purely temporal or purely spatial variations. Magnetic field disturbances calculated using these simple current models and the measured particle fluxes were in good agreement with measured field values. While fluxes of greater than 1 keV electrons are detected primarily on the nightside, magnetometer disturbances indicative of field-aligned currents were seen at all local times, both in the visual auroral regions and dayside polar cusp. Thus electrons with energies less than approximately 1 keV are the prime charge carriers in high latitude dayside field-aligned currents. The satellite measurements are in good agreement with previously measured field-aligned current values and with values predicted from several models involving magnetospheric field-aligned currents. Author

N73-21368*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE DETECTION OF INTERMEDIATE SIZE MAGNETIC ANOMALIES IN COSMOS-49 AND OGO-2, 4, AND 6 DATA
R. D. Regan (Geological Survey, Silver Spring, Md.), W. Minor Davis (Geological Survey, Silver Spring, Md.), and Joseph C. Cain Mar. 1973 13 p refs Submitted for publication
(NASA-TM-X-66225; X-645-73-89) Avail: NTIS HC $3.00 CSCL 08N

Benkova, Dolginov, and Simonenko have recently reported the presence of intermediate size magnetic anomalies in the data from COSMOS-49 and hypothesized a crustal and/or upper mantle origin. The spherical harmonic models of the internal potential function were examined, based on the OGO-2, 4, and

6 data (POGO (10/68) and later models), and verified the locations and amplitudes of those anomalies whose wavelengths approximate 4000 km. The comparison was made by subtracting a field model developed with a truncated series of $n^* = 9$ from one computed with $n^* = 11$ and generating a residual map equivalent to the COSMOS-49 data. The patterns of delta F so computed from POGO were then compared with the IZMIRAN maps and also were analyzed statistically, in both the spatial and frequency domains, using residuals computed from the raw COSMOS-49 data with the $n^* = 9$ COSMOS-49 field model as reference. The two sets of data were thus derived from completely independent sets of observations and field references. The two patterns are shown to agree very well over the whole earth surface up to the 50 deg latitude limit of COSMOS-49. Author

N73-21369# Kiruna Geophysical Observatory (Sweden).
MAGNETOTELLURIC EXPERIMENTS IN THE FREQUENCY RANGE 0.01 Hz TO 10 kHz
S. Westerlund Nov. 1972 40 p refs Sponsored by Swed. Board for Tech. Develop.
(KGO-72-10) Avail: NTIS HC $4.00

Magnetotelluric measurements at two sites were made. Conductivity at one site was found to be 10 times as high as at the other. At both sites conductivity varied with direction by about a factor of 30. The results obtained indicate that a two-dimensional model is too simple to explain ground response. The relationship between computed conductivities and ground structure is not clear. ESRO

N73-21370# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics.
IONOSPHERIC TEMPERATURE AND DENSITY MEASUREMENTS BY MEANS OF SPHERICAL DOUBLE PROBES
U. Fahleson, C.-G. Faelthammar, and A. Pedersen (ESRTC) Dec. 1972 67 p refs Sponsored by Swed. Space Res. Comm.
(TRITA-EPP-72-14-Rev) Avail: NTIS HC $5.50

The use of spherical double probes for measurements of ionospheric electric fields is demonstrated. These can also be used to obtain information on plasma density and temperature. The data from four Skylark rocket flights using such probes, particularly in regard to electron temperature and electron density profiles, are discussed. ESRO

N73-21371# Groupe de Recherches Ionospheriques, Issy-les-Moulineaux (France).
INFLUENCE OF THE POLARITY OF THE INTERPLANETARY FIELD ON MAGNETIC ACTIVITY AT HIGH LATITUDES
A. Berthelier and C. Guering Nov. 1972 13 p refs Presented at the COSPAR Symp. on Critical Probl. of Magnetosphere Phys., Madrid, 10-24 May 1972
(GRI/NT/87) Avail: NTIS HC $3.00

Relations between the polarity of the interplanetary magnetic field and magnetic activity have been investigated using a large amount of data related to over 70 solar rotations. A precise statistical analysis enabled the study of some of the principal aspects of the IMF polarity as geomagnetic variations. The results of the analysis are given. ESRO

N73-21372# SACLANT ASW Research Center, La Spezia (Italy).
MILOCMED 1968: A DROGUE EXPERIMENT IN THE IONIAN SEA. PART 1: THE TEMPERATURE TIME SERIES
Adolf Dahme and Andre DeHaen 15 Oct. 1972 40 p refs
(AD-753442; SACLANTCEN-TM-181) Avail: NTIS CSCL 08/10

During an oceanographic survey made in the Ionian Sea between 15 May and 5 June 1968, temperature profiles were obtained every three minutes by means of free-drifting, self-recording drogues equipped with 60 m long thermistor chains. The gathering and processing of two of these time series, one covering a period of 17 days and one a period of 4 days, are described. The results reported include an indication of an oceanographic front in the area that causes sharp horizontal changes in the temperature structure both above and below the thermocline. Author (GRA)

N73-21373# Utah State Univ., Logan. Space Science Lab.
SMALL ROCKET INSTRUMENTATION FOR MEASUREMENTS OF INFRARED EMISSIONS: ASTROBEE D30.205-3 AND ASTROBEE D30.205-4 Interim Report
Larry L. Jensen, John C. Kemp, and Ronald J. Bell Nov. 1972 88 p refs
(Contract F19628-70-C-0302; AF Proj. 7663)
(AD-755823; AFCRL-72-0691; SR-3) Avail: NTIS CSCL 04/1

Two Astrobee D payloads, developed and instrumented at the Space Science Laboratory, Utah State University, under contract with the Air Force Cambridge Research Laboratories, were flown from Poker Flat, Alaska, as part of ICECAP 72 -- a continuing auroral measurements program. The first payload (30.205-3) contained a cooled, dual-channel radiometer which measured OH emissions in the 1.4 to 1.65 micrometer and 1.85 to 2.12 micrometer bands and was flown into a quiet nighttime sky with respect to OH enhancement. The second payload (30.205-4) contained a cooled, circular variable filter spectrometer which measured the infrared radiation spectrum between 1.65 and 5.3 micrometer and was launched into a medium bright auroral display accompanied by indicated OH enhancement. Author (GRA)

N73-21374# Ballistic Research Labs., Aberdeen Proving Ground, Md.
DIURNAL CYCLES OF THE REFRACTIVE INDEX STRUCTURE FUNCTION COEFFICIENT
Marvin L. Wesley and Ernest C. Alcaraz Nov. 1972 35 p refs
(AD-755808; BRL-MR-2243) Avail: NTIS CSCL 04/1

The refractive index structure function coefficient, (C_n^2), is an atmospheric parameter needed to describe scintillation and small-scale phase fluctuations of electromagnetic radiation propagated in the atmospheric surface layer. Since systematic direct measurements of C_n for many climates and seasons are not available, an indirect method is developed where C_n is calculated from the estimates of sensible and latent heat flux components of the surface energy budgets. This indirect method is primarily for heights less than 4 meters, because low intermittency and $K(H)/K(M)$ about equal to 1 are assumed. Diurnal variations of C_n at several heights above land for six combinations of climates, seasons, and surface conditions are calculated from heat fluxes measured by different investigators at many locations, for moderate to high wind velocities. These predictions of C_n agree well with some direct measurements of C_n when assumptions of nearly ideal weather and sites are met. The effect of water vapor on C_n is usually a reduction of about 3/Beta per cent and thus is usually negligible above land, but can be significant above tropical oceans. Author (GRA)

N73-21375# Naval Ordnance Lab., White Oak, Md.
THE PROPAGATION OF GEOMAGNETIC MICROPULSATIONS INTO A TWO-LAYER CONDUCTING EARTH
Martin B. Kraichman 27 Oct. 1972 17 p refs
(AD-755428; NOLTR-72-261) Avail: NTIS CSCL 08/14

Geomagnetic micropulsation fields at the earth's surface are characterized by spatial variations along the surface that are associated with non-uniform plane waves in the Fourier spectrum representation of these near fields. Using both a single micropulsation frequency and a single spatial frequency in a two-layer conducting earth, expressions are derived for the field attenuation, the ratio of vertical to horizontal field, and the surface impedance. Numerical results are presented for a seawater layer over an earth bottom for a spatial frequency that is prominent in many micropulsations. Author (GRA)

N73-21376# Texas Instruments, Inc., Dallas. Equipment Group.
INVESTIGATION OF ZERO-FIELD (PARAMETRIC) RESONANCE MAGNETOMETER USING OPTICALLY PUMPED HELIUM Technical Report, 17 Nov. 1971 - 17 Nov. 1972
Robert E. Slocum 1 Feb. 1973 37 p refs
(Contract N00014-72-C-0104)
(AD-755256; TI-UI-844010-1) Avail: NTIS CSCL 08/14

The report describes the investigation of zero-field level crossing and the use of resulting resonances for measuring weak magnetic fields. This work includes investigation of zero-field level crossing in the 2 triplet S1 level of helium 4 investigation of modulated zero-field resonances in the same

level, and finally establishes the feasibility of constructing a low-field magnetometer using the parametric resonance n = 0, p = 1. A device of this type was demonstrated to have a peak-to-peak noise level of 1.0 x 10 to the minus 8th power G in a 0.5-Hz noise bandwidth. Author (GRA)

N73-21377# Physical Dynamics, Inc., Berkeley, Calif.
INTERACTION OF NON-SATURATED SURFACE GRAVITY WAVES WITH INTERNAL WAVES
J. Alex Thomson and Bruce J. West Oct. 1972 100 p refs
(Contract F30602-72-C-0494; ARPA Order 1649)
(AD-754281; PD-72-023; RADC-TR-72-280) Avail: NTIS CSCL 08/3

The interaction of surface gravity waves with non-dispersive internal waves is studied by solving the equations of motion in a coordinate system moving with the time independent surface current system induced by the internal wave. A range of surface wavelengths is found which is reflected by the current system (as seen in this coordinate system). In the ocean-fixed frame these waves are identified as waves which interact strongly with the internal waves and exchange energy with it. The effect on the surface wave pattern and the relation to surface slicks are discussed. Author (GRA)

N73-21378# North American Rockwell Corp., Downey, Calif. Space Div.
A MONOGRAPH ON APPLICATIONS OF MULTICOLOR DYE TRACERS AND MULTISPECTRAL PHOTOGRAPHY TO COASTAL WATER MAPPING
David T. Hodder Mar. 1972 26 p refs
(Contract N00014-72-C-0149)
(AD-754437; SD-72-SA-0071) Avail: NTIS CSCL 08/3

A new concept has been evolved for investigation of the morphology and 3-D transport of turbidity cells. The basic idea is to make use of the variable extinction (water penetration) depths for different bandwidths (plus or minus 100A) of the image forming light scattered through relatively turbid waters, and the narrow band slicing of the visible spectrum feasible with interference filters. The method of employing these phenomena and multiband imaging techniques is to make a multicolored dye release of dyes with characteristic spectral signatures as viewed with narrow band (interference) filters. These releases are to be made at depths which match the extinction depths for light in the respective dye characteristic signature bandwidths. The resulting dye patches are then imaged through narrow band interference filters matched to the characteristic spectral signature and extinction depths for each type of dye. Author (GRA)

N73-21379# GEOMET, Inc., Rockville, Md.
DEVELOP AND IMPLEMENT TECHNIQUES TO PREDICT SOLAR ACTIVITY AND ITS GEOPHYSICAL EFFECTS Final Report, Nov. 1969 - Oct. 1972
Isadore Enger, George E. Fisher, and Donald Chisholm Nov. 1972 40 p refs
(Contract F19628-70-C-0111; AF Proj. 8666)
(AD-755920; GEOMET-MF-161; AFCRL-72-0741) Avail: NTIS CSCL 04/1

The solar-geophysical data base previously assembled for the period January 1, 1955 through February 28, 1968, was extended to October 31, 1969. X-ray burst data were added to the base; 2-12A for the period July 3, 1966 through August 12, 1969 and 1-8A from March 13, 1968 through August 12, 1969. An objective technique was developed for predicting the duration of the largest short-wave fadeout event (SWF) expected to be associated with a sunspot group tomorrow. An unsuccessful attempt was made to develop techniques for predicting 2-12A X-ray burst decay time once the burst has started. Equations were developed for predicting the geomagnetic index a(p) from 3 through 24 hours ahead. Future work is outlined. All of the above is directed to assisting AFCRL in its program to improve the operational forecasting capabilities of the Air Weather Service Space Environmental Support System (SESS). Author (GRA)

N73-21380*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md. Lab Operations.
THE EFFECTS OF PHOTOELECTRON EMISSION ON A MULTIPLE-PROBE SPACECRAFT NEAR THE PLASMA PAUSE, NOVEMBER 1971 - SEPTEMBER 1972
David P. Cauffman El Segundo, Calif. Aerospace Corp. 1 Dec. 1972 24 p refs Presented at the Symp. on Photon and Particle Interactions with Surfaces in Space, Woordwijk, Netherlands Prepared by Aerospace Corp., El Segundo, Calif.
(Contract F04701-72-C-0073)
(NASA-TM-X-69313; AD-755901; TR-0073(9220-01)-2; SAMSO-TR-72-318) Avail: NTIS HC $3.25 CSCL 04/1

Measurements of the potential difference between a pair of symmetrical, spherical, floating probes (14-cm diameter, 5-m baseline) flown on the S(3)-A (Explorer 45) spacecraft (launched November 1971, with apogee 5.2 (R sub e), perigee 222 km, and inclination 3.6 deg) have shown a complicated response to sheath potentials in the region near and inside the plasmapause. Typically, with increasing altitude (1) the sunward sphere will first assume a more negative potential than the antisunward sphere, (1) the polarities of the probes in the region L = 2 to 4 may switch, sometimes several times, and (3) finally, the detector output may saturate (delta phi = 125 mV) with the sunward sphere more negative again. Author (GRA)

N73-21381# Aerospace Corp., El Segundo, Calif.
PRECIPITATION OF AURORAL AND RING-CURRENT PARTICLES BY ARTIFICIAL PLASMA INJECTION
John M. Cornwall 30 Jan. 1973 30 p refs
(Contract F04701-72-C-0073)
(AD-755352; TR-0073(3260-20)-9; SAMSO-TR-72-316) Avail: NTIS CSCL 04/1

Outside the plasmasphere, most of the energy in magnetospherically trapped particles resides in two populations: auroral-energy electrons, and the proton ring current, with single-particle energies from 1 to 50 keV. The ring current contains more energy than all other components of the magnetospherically trapped radiation. It may be possible to precipitate a large fraction of this energy into the ionosphere by injection of a light-ion plasma from a synchronous satellite, which would render the ring current protons unstable to a variety of plasma modes. Author (GRA)

N73-21382# Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.
EXTREMES OF LOW ATMOSPHERIC DENSITY NEAR THE GROUND FOR ELEVATIONS UP TO 15,000 FEET FOR MIL-STD-210B Air Force Surveys in Geophysics
Rene V. Cormier 6 Dec. 1972 23 p refs
(AF Proj. 8624)
(AD-755791; AFCRL-72-0711; AFCRL-AFSIG-251) Avail: NTIS CSCL 04/1

Atmospheric density, especially low values thereof, is important to aircraft takeoff and landing operations. Such extremes must be considered in aircraft design and are therefore to be included in MIL-STD-210B. This document provides environmental design criteria to designers of military equipment, and requires for the most extreme area and month, values of low density that are equalled or surpassed during, 1, 5, 10, and 20 percent of the time for ground elevations up to 15,000 feet. Typical temperatures accompanying these values, needed for engine power calculations, are also required. This report provides these densities and temperatures. In addition, empirical equations, being used by the USAF Environmental Technical Applications Center, for estimating extremes of low density near the ground, are evaluated. Author (GRA)

N73-21383# Pennsylvania State Univ., University Park. Ionosphere Research Lab.
MODEL STUDIES OF THE LOWER IONOSPHERE
John N. Rowe 14 Dec. 1972 215 p refs
(Contract N00014-67-A-0385-0014; Grant NSF GA-13885)
(AD-755447; PSU-IRL-SCI-406) Avail: NTIS CSCL 04/1

A summary of quiet D-region electron density measurements made by the wave interaction technique at The Pennsylvania State University for the period October 1969 - January 1971 is presented. Some estimate of the uncertainty in these measurements is given also. The mean electron density profile for July 1970 noon and the measured relative positive ion composition are used as constraints to develop a model of D-region ion chemistry between 60 and 80 kilometers. The neutral densities were taken from previous experimental and theoretical studies.

Electron production rates due to Lyman-alpha, ultraviolet, X-rays, and galactic cosmic rays were considered. Some estimates are reported of the rate of conversion of NO-ions into water cluster ions, the NO density and the detachment rate. It is concluded that the model developed for summer noon conditions will predict reasonably well the average seasonal and diurnal behavior of the D-region electron density, in spite of uncertainties in the neutral chemistry. Author (GRA)

N73-21512 Joint Publications Research Service, Arlington, Va.
CONSERVATION OF LAKE BAYKAL
Yu. A. Izrael and A. A. Zenin *In its* Meteorol. and Hydrol., No. 1, Jan. 1973 15 Mar. 1973 p 16-22 (For availability see N73-21510 12-20)

N73-21516 Joint Publications Research Service, Arlington, Va.
PROCEDURE FOR CALCULATING OCEAN CURRENTS BY A GIVEN DENSITY FIELD
V. F. Kozlov *In its* Meteorol. and Hydrol., No. 1, Jan. 1973 15 Mar. 1973 p 56-63 refs (For availability see N73-21510 12-20)

N73-21797* Scientific Translation Service, Santa Barbara, Calif.
TECHNIQUE OF MAPPING AND A LEGEND FOR GEOLOGICAL-MORPHOLOGICAL MAPS OF THE MOON ON A SCALE OF 1:1000000
A. L. Sukhanov and V. G. Trifonov *In its* Probl. of Lunar Geol. Jan. 1973 p 8-42 refs (For availability see N73-21795 12-30) CSCL 08B

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N73-21384 Illinois Univ., Urbana.
HIGH PRECISION STEREOMETRIC SYSTEMS Ph.D. Thesis
Roop Chand Malhotra 1972 626 p
Avail: Univ. Microfilms Order No. 72-19874

An investigation of theoretical and experimentally achievable internal precisions and external accuracies of various stereometric systems is made. This study is restricted to stereometric systems consisting of a single stereometric camera, the metrical chambers of which are capable of being oriented in any direction and separated from each other by any distance desired. The study brings out certain desirable characteristics and capabilities of an ideal universal stereometric system capable of achieving high precision. Some recommendations are made concerning the design features and procedures for data acquisition and data reduction in order to attain high precision by such a system.
Dissert. Abstr.

N73-21385*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
PHOTOGRAMMETRY AND PHOTO INTERPRETATION APPLIED TO ANALYSES OF CLOUD COVER, CLOUD TYPE, AND CLOUD MOTION
Paul A. Larsen Jun. 1972 80 p refs Original contains color illustrations
(NASA-TM-X-64710) Avail: NTIS HC $6.00 CSCL 14E

A determination was made of the areal extent of terrain obscured by clouds and cloud shadows on a portion of an Apollo 9 photograph at the instant of exposure. This photogrammetrically determined area was then compared to the cloud coverage reported by surface weather observers at approximately the same time and location, as a check on result quality. Stereograms prepared from Apollo 9 vertical photographs, illustrating various percentages of cloud coverage, are presented to help provide a quantitative appreciation of the degradation of terrain photography by clouds and their attendant shadows. A scheme, developed for the U.S. Navy, utilizing pattern recognition techniques for determining cloud motion from sequences of satellite photographs, is summarized. Clouds, turbulence, haze, and solar altitude, four elements of our natural environment which affect aerial photographic missions, are each discussed in terms of their effects on imagery obtained by aerial photography. Data of a type useful to aerial photographic mission planners, expressing photographic ground coverage in terms of flying height above terrain and camera focal length, for a standard aerial photograph format, are provided. Two oblique orbital photographs taken during the Apollo 9 flight are shown, and photointerpretations, discussing the cloud types imaged and certain visible geographical features, are provided. Author

N73-21386*# National Research Corp., Cambridge, Mass.
DESIGN, FABRICATION, ASSEMBLY AND DELIVERY OF A LABORATORY PROTOTYPE OF A RESIDUAL GAS ANALYZER Final Report
W. S. Kreisman, F. L. Torney, and J. R. Roehrig 22 Nov. 1972 75 p
(Contract NAS8-27877)
(NASA-CR-124177) Avail: NTIS HC $5.75 CSCL 14B

The design, development, and testing of a wide mass range residual gas analyzer which will be one component of an integrated real time contamination monitor system are described. The instrument has been developed and tested to the laboratory prototype phase, demonstrating the performance that can be expected from a flight instrument of similar design. The instrument's analyzer is of the quadrupole type and a cold cathode ion source is employed as the ionizer. The associated electronics supply all necessary operating and mass sweep voltages for the ionizer, analyzer and electron multiplier ion detector. The instrument features a very fast linear electrometer with automatic range changing. The full mass range of 2 to 300 amu is automatically and repetitively scanned every sixty seconds and suitable telemetry outputs are provided for intensity and mass identification as well as a digital identification of the electrometer range. Author

N73-21387*# Rocketdyne, Canoga Park, Calif.
STUDY OF DUAL-CHANNEL INFRARED SPECTRORADIOMETER SYSTEMS Final Report, Jun. 1967 - Feb. 1973
J. A. Wrubel Mar. 1973 123 p refs
(Contract NAS8-21144)
(NASA-CR-124207) Avail: NTIS HC $8.25 CSCL 14B

A dual channel infrared spectroradiometer system was installed at a high altitude facility where spectral data were obtained from F2/H2, FLOX/CH4, FLOX/B2H6, OF2/CH4, and OF2/B2H6 propellant combinations. A good HF emission spectra was obtained for tests with the OF2B2H6 propellant combination. Subsequently, data were obtained on the LOX/GH2 propellant combination at sea level and altitude conditions that were inconsistent because the calculation of plume properties led to physically unrealistic results. The inconsistencies resulted from measurement accuracy not being within the narrow limits required by the data reduction scheme. Although the anticipated program results were not obtained, the data gathered are useful for guiding future experimental efforts and formulations of less sensitive analytical models. Author

N73-21388*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A HIGH-SPEED PHOTOGRAPHIC SYSTEM FOR FLOW VISUALIZATION IN A STEAM TURBINE
Gerald J. Barna Washington Apr. 1973 28 p refs
(NASA-TM-X-2763; E-7279) Avail: NTIS HC $3.00 CSCL 14E

A photographic system was designed to visualize the moisture flow in a steam turbine. Good performance of the system was verified using dry turbine mockups in which an aerosol spray simulated, in a rough way, the moisture flow in the turbine. Borescopes and fiber-optic light tubes were selected as the general instrumentation approach. High speed motion-picture photographs of the liquid flow over the stator blade surfaces were taken using stroboscopic lighting. Good visualization of the liquid flow was obtained. Still photographs of drops in flight were made using short duration flash sources. Drops with diameters as small as 30 micrometers (0.0012 in.) could be resolved. In addition, motion pictures of a spray of water simulating the spray off the rotor blades and shrouds were taken at normal framing rates.

Specially constructed light tubes containing small tungsten-halogen lamps were used. Sixteen millimeter photography was used in all cases. Two potential problems resulting from the two-phase turbine flow (attenuation and scattering of light by the fog present and liquid accumulation on the borescope mirrors) were taken into account in the photographic system design but not evaluated experimentally. Author

N73-21389*# Research Triangle Inst., Durham, N.C.
EXPERIMENTAL PROGRAM TO DETERMINE LONG TERM CHARACTERISTICS OF THE MDE PRESSURE TRANSDUCERS Final Report
C. D. Parker Jan. 1973 141 p refs
(Contract NAS1-10175)
(NASA-CR-112273) Avail: NTIS HC $9.25 CSCL 14B

The pressure cell sensors developed for the Pioneer 10/G meteoroid detection experiments (MDE) were investigated to enhance their application and their potential as a sensor in other MDE applications. Their Paschen characteristics were also investigated, and the effects of variations in geometry, Ni-63 platings (for initial ionizations) and sealing pressures were determined. The effects of extensive pre-flight testing and proton and heavy ion space radiation were investigated. Flight-quality pressure panels/cells were committed to long term testing to demonstrate their suitability for the Pioneer 10/G Missions. Author

N73-21390*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
DUAL WAVELENGTH SCANNING DOPPLER VELOCIMETER Patent Application
Kenneth L. Orloff, George R. Grant, and William D. Gunter, Jr., inventors (to NASA) Filed 18 Apr. 1973 20 p
(NASA-Case-ARC-10637-1; US-Patent-Appl-SN-352383) Avail: NTIS HC $3.00 CSCL 14B

An optical measuring device, for simultaneously measuring the velocity characteristics of fluids within a moving stream without perturbing the flow field, is described. The procedure a first pair of beams of a first common wavelength and a second pair of beams of a second common wavelength which are derived from a single laser source, directed along a single optical axis such that the respective beams of each pair of beams are disposed parallel to the axis, symmetrically about the axis, and are positioned orthogonally about the axis relative to each other. The four beams are then focused upon a selected test volume within the flow field and light scattered at that point is collected by an appropriate optical system and focused onto photodetectors which develop electrical output signals commensurate with the orthogonal velocity components at the test point. NASA

N73-21391# Joint Publications Research Service, Arlington, Va.
PROBLEMS OF THE DEVELOPMENT OF INSTRUMENT MAKING
K. N. Rudnev 16 Apr. 1973 11 p Transl. into ENGLISH from Planovoye Khoz. (Moscow), no. 1, Jan. 1973 p 8-14
(JPRS-58746) Avail: NTIS HC $3.00

The problems of developing, producing, and introducing instruments, automation equipment, and control systems are discussed. Author

N73-21392*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THE GAERTNER L119 ELLIPSOMETER AND ITS USE IN THE MEASUREMENT OF THIN FILMS
Michael Linkous 16 Mar. 1973 43 p refs
(NASA-TM-X-64742) Avail: NTIS HC $4.25 CSCL 14B

An introduction to the study of ellipsometry is presented, with special attention given to the Gaertner model L119 ellipsometer and the techniques of measuring thin films with this instrument. Values obtained from the ellipsometer are analyzed by a computer program for a determination of optical constants and thickness of the film. Author

N73-21393*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A TWO COLOR, DUAL BEAM BACKSCATTERING LASER DOPPLER VELOCIMETER
George R. Grant and Kenneth L. Orloff Mar. 1973 15 p refs
(NASA-TM-X-62254) Avail: NTIS HC $3.00 CSCL 14B

A laser Doppler velocimeter has been developed which uses two of the colors emitted from an argon ion laser for the simultaneous measurement of orthogonal velocities. Designed for use in a 2.13 m by 3.05 m wind tunnel, it is capable of traversing its focal volume across spatially unstable flows at scan speeds of up to 1.15 m/sec. Its optical layout and principles of operation are discussed and the data from a typical traversal of a trailing wing tip vortex are presented. Author

N73-21394*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
PHASE A REACTION CONTROL SYSTEM DESIGN FOR THE LARGE SPACE TELESCOPE (LST)
William B. Price Dec. 1972 42 p refs
(NASA-TM-X-64740) Avail: NTIS HC $4.25 CSCL 14B

The design of a reaction control system (RCS) for the Large Space Telescope is discussed. The primary requirement for the RCS is to serve as an emergency backup control system to the primary attitude control system. A regulated gaseous nitrogen RCS was selected. The operation of the system and its individual components is described. The principal design goals of the RCS were to minimize contamination effects, make use of existing components, and modularize the system to provide ease in manned orbital maintenance. Author

N73-21395# Lockheed Missiles and Space Co., Palo Alto, Calif.
RESPONSE OF OPTICOELECTRONIC SCANNING SYSTEMS WITH ANTIPHASE CONNECTION OF RADIATION DETECTOR ELEMENTS
Iu. N. Rakovskii [1973] 2 p ref Transl. into ENGLISH from Opiko-Mekh. Prom. (Leningrad), no. 1, 1973 p 14-15
Avail: NTIS HC $3.00; National Translations Center, John Crerar Library, Chicago, Ill. 60616

A mathematical analysis is made of systems with antiphase connection of the detector elements. The results of the analysis show that the antiphase connection does not change the threshold response for both white and hyberbolic noise spectra of a radiation detector by diminishing the influence of prolonged background interference on the systems. D.L.G.

N73-21396# Los Alamos Scientific Lab., N.Mex.
FIELD PHOTOGRAPHY OF PROJECTILES IN FLIGHT
P. M. Giles Oct. 1972 9 p refs
(Contract W-7405-eng-36)
(LA-5030) Avail: NTIS

The current status of techniques and equipment developed specifically to photograph artillery projectiles in flight is documented. Fixed-slit and rotating-slit shuttered cameras are described as is stop-motion flash photography employing fixed sheet and drum-rotated film. Author

N73-21397# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.
SPECTROMETRIC ANALYSIS OF NONCONDUCTORS BY MEANS OF A LUMINESCENT DISCHARGE
M.-E. Ropert and H. Drevon 1972 4 p In FRENCH Presented at 31st Congr. of the Group for the Advancement of Phys. Methods of Anal., Paris, 5 Jun. 1972
(CEA-Conf-2060; Conf-720660-1) Avail: AEC Depository Libraries

General principles and functions of a luminescent discharge source applied to spectral analysis are reported. Results obtained from an experimental study on the technological aspects of the problem, in particular the nature and granular properties of a flexible conductor are given. A general operational model appliable to siliceous rocks and related materials is proposed. Transl. by E.H.W.

N73-21398# Pittsburgh Univ., Pa. Dept. of Chemistry.
MICROWAVE-OPTICAL DOUBLE RESONANCE SPECTROSCOPY Progress Report, 1 Feb. 1972 - 31 Jan. 1973
D. W. Pratt 1 Nov. 1972 31 p refs
(Contract AT(11-1)-3435)
(COO-3435-6) Avail: NTIS

Research progress is reported on the application of microwave-optical double resonance (MODR) techniques to the study

of the structural properties of the phosphorescent triplet states of organic molecules. It is shown how it is possible to obtain the signs and magnitudes of the zero field parameters of the triplet state by careful analysis of the temperature dependence of the MODR spectrum of 1, 2, 4, 5-tetrachlorobenzene (TCB) in durene. Measurements were completed of the anisotropy of the g and zero field tensors of both TCB and the corresponding tetrabromobenzene (TBB) derivative. Preliminary results of similar measurements on several other systems are also described. In addition, measurements of the magnetic field dependence of the phosphorescence lifetimes of TCB and TBB in durene are presented, and it is shown how this information can be used to determine the field dependence of electron spin lattice relaxation in the absence of microwaves. Author (NSA)

N73-21399# Los Alamos Scientific Lab., N.Mex.
STORED PROGRAM CONTROLLER FOR A THREE CHANNEL TWO AXIS SCANNING PHOTOMETER
D. L. Stephenson 1972 6 p Presented at 3d Symp. on Stored Program Controllers, Los Alamos, N. Mex., 16 Oct. 1972 Sponsored by AEC
(LA-DC-72-1422; Conf-721047-6) Avail: NTIS

Scientific measurements of such natural phenomena as air glow, aurora, and sun's corona as well as man-generated optical phenomena such as barium releases, utilize columnated narrow-field-of-view extremely sensitive photometers. These photometers are essentially telescopes with photosensors at the focal point. Spectral information is obtained by interposing variable spectral filters in the optical path. The objective of such measurements is to map an arbitrary and well defined window in the sky from a high flying NC-135 aircraft to determine not only light intensity versus pointing angle, but also the spectral content of the incident light flux at each pointing angle. This paper describes a two-unit stored program controller capable of providing arbitrary stored program control of both the pointing and spectral parameters.
Author

N73-21400# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugfuehrung.
ASSESSMENT OF COCKPIT DISPLAYS [WIRKSAMKEITSUNTERSUCHUNGEN VON ANZEIGEN FUER DIE FLUGFUEHRUNG]
Ralf Beyer 1973 32 p refs In GERMAN; ENGLISH summary
(DLR-FB-73-03) Avail: NTIS HC $3.75; DFVLR, Porz, West Ger.: 9,50 DM

A limited survey of some methods for assessment and evaluation of new and predominantly electronic display techniques is given. Particular emphasis is laid on control technology, experimental psychology, physiology, and subjective rating. The survey is supported by results drawn from various experiments.
ESRO

N73-21401# Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass. Space Physics Lab.
ACCIDENTAL COINCIDENCES IN THE ELECTRON SPECTROMETER ON SATELLITE OV1-13
Joseph G. Kelley 10 Oct. 1972 26 p ref
(AF Proj. 8600)
(AD-755789; AFCRL-72-0592; PSRP-513) Avail: NTIS CSCL 18/4

Low energy particles incident on the front detector in coincidence with the penetration of high energy particles through the side of this instrument to its rear detector may cause significant error in the fluxes recorded. In order to determine the severity of such errors, the probability of such accidentals is calculated and evaluated using the highest expected fluxes that will contribute to it. These results are then applied to data obtained from OV1-13. It is found that significant error is possible only near L = 1.4. In this region the erroneous flux recorded in any channel is never greater than the total flux recorded in the highest energy (lowest flux) channel. Subtraction of the flux (if any) recorded in this highest energy channel from that recorded in each of the other channels will produce an improved spectrum.
Author (GRA)

N73-21402# Aerospace Corp., El Segundo, Calif.
HOLOGRAPHY IN A RANDOM SPATIALLY INHOMOGENEOUS MEDIUM Research Report, May - Jul. 1972
Harold T. Yura 30 Nov. 1972 26 p refs
(Contract F04701-72-C-0073)
(AD-755781; TR-0073(9230-10)-3; SAMSO-TR-73-37) Avail: NTIS CSCL 14/5

The Huygens-Fresnel principle, extended to a medium that exhibits a random spatial variation in the index of refraction, is used to calculate the resulting fringe patterns in the Fresnel-Fraunhofer and point-reference Fourier transform methods of holography. The resolution limits pertaining to these two methods are derived. In the Fresnel-Fraunhofer method, the effect of the medium is a lateral reduction in the size of the hologram, which leads to a corresponding loss of resolution. In the point-reference Fourier-transform method, on the other hand, the medium does not limit the lateral extent of the hologram but gives a uniform reduction in contrast to the resulting fringe pattern. Thus, in the latter method, resolution is not degraded, but the medium does limit the size of objects that can form holograms. Numerical results pertaining to underwater holography are given.
Author (GRA)

N73-21403# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
TRUE AIRSPEED SENSOR FOR V/STOL AIRCRAFT Technical Report, 1 Jul. 1970 - 31 Mar. 1972
K. W. McElreath Dec. 1972 37 p refs
(AF Proj. 643A)
(AD-755374; AFFDL-TR-72-131) Avail: NTIS CSCL 01/4

One factor which has hindered the development of an effective low-speed flight control capability for helicopters and other V/STOL aircraft is the lack of an accurate airspeed sensor which will operate at speeds below 40 knots. One device which does meet this requirement is an advanced electronic true airspeed sensor developed by J-Tec Associates of Cedar Rapids, Iowa. Under the USAF Flight Dynamics Laboratory's Advanced Development Program 643A, 'Tactical Airlift Technology,' a J-Tec Associates true airspeed sensor has been evaluated for use by low-speed aircraft, using a Sikorsky CH-3E helicopter as a test bed. The results of the wind-tunnel and flight testing conducted at Wright-Patterson AFB showed that the sensor has excellent characteristics particularly in the low-speed flight regime, where it maintained its accuracy even at high yaw and pitch angles.
Author (GRA)

N73-21404# Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.
CALIBRATION OF A MAGNETIC SPECTROMETER DESIGNED TO MEASURE 0.1 - 1.0 MeV ELECTRONS IN SPACE Physical Sciences Research Papers
Paul L. Rothwell and Wayne R. Moomey 6 Dec. 1972 28 p refs
(AF Proj. 8600)
(AD-755790; AFCRL-72-0710; AFCRL-PSRP-516) Avail: NTIS CSCL 18/4

The report describes the recalibration of a magnetic spectrometer designed to measure the 0.1 to 1.0 MeV electron flux in a space environment. A different technique from that of the original calibration was used. In the present case, a Monte Carlo computer program and beta source measurements are used to determine the detected energies and their detection efficiencies. The mean energies were 20 to 40 keV higher and the normalizations were a factor of two higher than those previously found. Systematic errors effects and the degree of elastic scattering of the magnet faces are analyzed. Author (GRA)

N73-21518 Joint Publications Research Service, Arlington, Va.
SOME RESULTS OF EXPERIMENTS IN INCREASING THE STABILITY IN THE FLOW OF BPV TYPE CURRENT METERS
V. B. Titov *In its* Meteorol. and Hydrol., No. 1, Jan. 1973 15 Mar. 1973 p 79-87 refs (For availability see N73-21510 12-20)

N73-21745* Naval Research Lab., Washington, D.C.
FAR UV CAMERA/SPECTROGRAPH
George R. Carruthers and Thornton Page *In* NASA. Lyndon B. Johnson Space Center Apollo 16 Prelim. Sci. Rept. 1972 14 p refs (For availability see N73-21729 12-30)
CSCL 14B

N73-21751* State Univ. of New York, Albany.
UV PHOTOGRAPHY OF THE EARTH AND MOON
Tobias Owen *In* NASA. Lyndon B. Johnson Space Center Apollo 16 Prelim. Sci. Rept. 1972 5 p refs (For availability see N73-21729 12-30)
CSCL 14E

N73-21752* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
GAMMA RAY SPECTROMETER EXPERIMENT
James R. Arnold (Calif. Univ., San Diego), Albert E. Metzger (JPL), Laurence E. Peterson (Calif. Univ., San Diego), Robert C. Reedy (Calif. Univ., San Diego), and J. I. Trombka *In its* Apollo 16 Prelim. Sci. Rept. 1972 8 p refs (For availability see N73-21729 12-30)
CSCL 14B

N73-21753* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
X-RAY FLUORESCENCE EXPERIMENT
I. Adler, J. I. Trombka, J. Gerard, P. Lowman, R. Schmadebeck, H. Blodget, E. Eller, L. Yin, R. Lamothe, G. Osswald et al *In its* Apollo 16 Prelim. Sci. Rept. 1972 14 p refs (For availability see N73-21729 12-30)
CSCL 14B

N73-21754* American Science and Engineering, Inc., Cambridge, Mass.
ALPHA-PARTICLE SPECTROMETER EXPERIMENT
Paul Gorenstein and Paul Bjorkholm *In* NASA. Lyndon B. Johnson Space Center Apollo 16 Prelim. Sci. Rept. 1972 6 p refs (For availability see N73-21729 12-30)
CSCL 14B

N73-21755* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
LUNAR ORBITAL MASS SPECTROMETER EXPERIMENT
R. R. Hodges (Texas Univ., Dallas), J. H. Hoffman (Texas Univ., Dallas), and D. E. Evans *In its* Apollo 16 Prelim. Sci. Rept. 1972 6 p refs (For availability see N73-21729 12-30)
CSCL 14B

N73-21757* California Univ., Los Angeles.
THE PARTICLES AND FIELDS SUBSATELLITE MAGNETOMETER EXPERIMENT
P. J. Coleman, Jr., B. R. Lichtenstein, C. T. Russell, G. Schubert, and L. R. Sharp *In* NASA. Lyndon B. Johnson Space Center Apollo 16 Prelim. Sci. Rept. 1972 13 p refs (For availability see N73-21729 12-30)
CSCL 14B

N73-21790* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
PHOTOGRAMMETRY AND ALTIMETRY. PART A: APOLLO 16 LASER ALTIMETER
W. R. Wollenhaupt and W. L. Sjogren (JPL) *In its* Apollo 16 Prelim. Sci. Rept. 1972 5 p (For availability see N73-21729 12-30)
CSCL 14B

N73-21791* Geological Survey, Washington, D.C.
PHOTOGRAMMETRY USING APOLLO 16 ORBITAL PHOTOGRAPHY, PART B
Sherman S. C. Wu, Francis J. Schafer, Raymond Jordan, and Gary M. Nakata *In* NASA. Lyndon B. Johnson Space Center Apollo 16 Prelim. Sci. Rept. 1972 5 p (For availability see N73-21729 12-30)
CSCL 14E

N73-21793* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
ASTRONOMICAL PHOTOGRAPHY. PART A: GUM NEBULA, GALACTIC CLUSTER, AND ZODIACAL LIGHT PHOTOGRAPHY
R. D. Mercer (Dudley Obs.), L. Dunkelman, and Thomas K. Mattingly *In its* Apollo 16 Prelim. Sci. Rept. 1972 2 p (For availability see N73-21729 12-30)
CSCL 14E

N73-21794* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
SOLAR CORONA PHOTOGRAPHY, PART B
R. M. MacQueen (High Altitude Obs.), C. L. Ross (High Altitude Obs.), and Thomas K. Mattingly *In its* Apollo 16 Prelim. Sci. Rept. 1972 2 p refs (For availability see N73-21729 12-30)
CSCL 14E

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control; reliability; drafting; and materials fabrication, handling, and inspection.

N73-21405 National Lending Library for Science and Technology, Boston Spa (England).
EMBRITTLEMENT OF AUSTENITIC WELDED JOINTS AND WELDED CLADDINGS
M. Puschner 4 Dec. 1972 13 p refs Transl. into ENGLISH from Chem.-Ing-Tech. (West Berlin), v. 44, no. 12, 1972 p 753-757
(NLL-Risley-Tr-2508-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The embrittlement of austenitic welded joints and welded claddings is discussed. The binary structure of austenitic chromium-nickel steels is described. The effects of heat due to welding on the microstructure and strength of the metal are analyzed.
Author

N73-21406 National Lending Library for Science and Technology, Boston Spa (England).
STUDIES ON WEAR AND MOVEMENT OF HIGH-SPEED ROLLING BEARINGS BY MEANS OF RADIOISOTOPES
Bernhard Herkert 4 Dec. 1972 14 p Transl. into ENGLISH from Motortech. Z. (West Germany), v. 33, no. 5, May 1972 p 187-192
(NLL-Risley-Tr-2524-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The development of methods of instrumentation for determining the kinematics and wear if high speed and lightly loaded rolling bearings is discussed. The service life of the bearings is based on the fatigue of the bearing materials, which result in cracks, pitting, and peeling of the bearing materials. Wear experiments with activated bearings were conducted to determine running conditions which might lead to premature failure.
Author

N73-21407 Georgia Inst. of Tech., Atlanta.
MODEL STUDIES OF VACUUM SINTERING TREATED AS A CREEP PROCESS Ph.D. Thesis
Ronald William Umphrey 1972 130 p
Avail: Univ. Microfilms Order No. 72-20613

Initial stage sintering of sphere plane models is studied in high vacuum atmosphere. Copper is tested at 900 to 1000 C and silver at 800 C in a specially constructed apparatus. External compressive loading is applied to the specimens during testing. An original derivation of the approximate stresses due to surface tension in the specimen neck is featured. Creep mechanisms are identified by determination of the stress dependence of the neck growth (strain) rate. A step change in the external load and measurement of the resultant change in strain rate lead to calculation of a stress exponent which in turn provides information concerning the creep mechanism most active at that time. Neck growth is followed by measuring the electrical resistance of the specimen neck at frequent intervals. A correlation is presented between neck size and electrical resistance for the nearly atomically clean specimens. Stress exponents for the lower levels indicate that creep is due mainly to dislocation climb in low-angle grain boundaries and/or prismatic dislocation loops.
Dissert. Abstr.

N73-21408*# Battelle Columbus Labs., Ohio.
NONCONTACTING DEVICES TO INDICATE DEFLECTION AND VIBRATION OF TURBOPUMP INTERNAL ROTATING PARTS Final Report
D. B. Hamilton, Dale Ensminger, D. R. Grieser, A. M. Plummer, E. J. Saccocio, and J. W. Kissel 12 Mar. 1973 144 p
(Contract NAS8-26903)
(NASA-CR-124208) Avail: NTIS HC $9.25 CSCL 13K

The research is reported which was conducted to develop devices for measuring vibrations and deflections of parts, such as impellers, shafts, turbine wheels, and inducers in operating turbopumps. Three devices were developed to the breadboard stage: ultrasonic Doppler transducer, flash X-rays, and light-pipe reflectance. It was found that the X-ray technique is applicable to the shaft assembly and the turbine seal of the J-2 pump, and the light-pipe-reflectance device appears to be ideal for cryogenic pump sections. F.O.S.

N73-21409*# Tennessee Univ., Knoxville.
VISCOSEAL PERFORMANCE WITH RAREFIED-GAS SEALANT
Mancil W. Milligan Apr. 1973 115 p refs
(Grant NGL-43-001-023)
(NASA-CR-121089; AE-71-023-9) Avail: NTIS HC $7.75 CSCL 11A

A fundamental study of viscoseals having a rarefied gas as the sealant was conducted. Both experimental and analytical investigations are reported. Three different analytical models were formulated and are described in detail. An experimental investigation was conducted on multiple grooved two-inch diameter viscoseals over a wide range of gas densities and shaft speeds up to 30,000 rpm. Comparisons are presented between actual viscoseal performance and the theoretical predictions for both sealing coefficient and net leakage parameters as functions of the degree of gas rarefication. Recommendations are presented for the use of the analytical models. Author

N73-21410*# Mechanical Technology, Inc., Latham, N.Y.
DESIGN AND FABRICATION OF GAS BEARINGS FOR BRAYTON CYCLE ROTATING UNIT
A. Frost, J. M. Tessarzik, E. B. Arwas, and W. D. Waldron, ed. Mar. 1973 161 p
(Contract NAS3-10951)
(NASA-CR-121098; MTI-72TR34) Avail: NTIS HC $10.25 CSCL 13I

Analysis, design, and testing of two types of pivoted pad journal bearings and a spiral-grooved thrust bearing suitable for direct installation into the NASA 2 to 15 KW Brayton Cycle Rotating Unit (BRU) have been accomplished. Both types of tilting pad bearing assemblies are of the preloaded type, consisting of three pads with one pad flexibly mounted. One type utilizes a non-conforming pivot, while the other replaces the conventional spherical pivot with a cruciform flexible member. The thrust bearing is flexure mounted to accommodate static machine mislinement. Test results indicate that both types of journal bearings should satisfy the requirements imposed by the BRU. Hydrostatic tests of the spiral-grooved thrust bearing showed it to be free of pneumatic hammer with as many as 24 orifices over the BRU pressure and load range. Author

N73-21411*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PITTING FATIGUE CHARACTERISTICS OF AISI M-50 AND SUPER NITRALLOY SPUR GEARS
Dennis P. Townsend, James L. Chevalier, and Erwin V. Zaretsky Washington Apr. 1973 22 p refs Prepared in cooperation with Army Air Mobility R and D Lab., Cleveland
(NASA-TN-D-7261; E-7164) Avail: NTIS HC $3.00 CSCL 13I

Two groups of 3.50-in. pitch-diameter spur gears, without tip relief, made from consumable-electrode vacuum-melted (CVM) AISI M-50 steel and CVM super nitralloy (5Ni-2A1) were tested under conditions which produced fatigue pitting. The M-50 gears had fatigue lives approximately 50 percent longer than the super nitralloy gears. Both groups of gears failed by classical rolling-element fatigue at the pitch circle. When the gears were overrun past initial spall formation, the spalled M-50 gear teeth failed by fatigue fracture. The M-50 material had higher wear than the super nitralloy material. Differences in fatigue life and wear were not considered statistically significant. Author

N73-21412*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ANALYTICAL STUDY OF PRESSURE BALANCING IN GAS FILM SEALS
John Zuk 3 May 1973 34 p refs Presented at 1973 Ann. Meeting of the Am. Soc. of Lubrication Engr., Chicago, 30 Apr. - 3 May 1973
(NASA-TM-X-68227; E-7430) Avail: NTIS HC $3.75 CSCL 11A

The load factor is investigated for subsonic and choked flow conditions, laminar and turbulent flows, and various seal entrance conditions. Both parallel sealing surfaces and surfaces with small linear deformation were investigated. The load factor for subsonic flow depends strongly on pressure ratio; under choked flow conditions, however the load factor is found to depend more strongly on film thickness and flow entrance conditions rather than pressure ratio. The importance of generating hydrodynamic forces to keep the seal balanced under severe and multipoint operation is also discussed. Author

N73-21413*# Northwestern Univ., Evanston, Ill.
RHEOLOGICAL EFFECTS ON FRICTION IN ELASTOHYDRODYNAMIC LUBRICATION
Edward G. Trachman and H. S. Cheng Washington NASA Mar. 1973 213 p refs
(Grant NGL-14-007-084)
(NASA-CR-2206) Avail: NTIS HC $3.00 CSCL 11H

An analytical and experimental investigation is presented of the friction in a rolling and sliding elastohydrodynamic lubricated contact. The rheological behavior of the lubricant is described in terms of two viscoelastic models. These models represent the separate effects of non-Newtonian behavior and the transient response of the fluid. A unified description of the non-Newtonian shear rate dependence of the viscosity is presented as a new hyperbolic liquid model. The transient response of viscosity, following the rapid pressure rise encountered in the contact, is described by a compressional viscoelastic model of the volume response of a liquid to an applied pressure step. The resulting momentum and energy equations are solved by an iterative, numerical technique, and a friction coefficient is calculated. The experimental study was performed, with two synthetic paraffinic lubricants, to verify the friction predictions of the analysis. The values of friction coefficient from theory and experiment are in close agreement. Author

N73-21414*# Lockheed Missiles and Space Co., Palo Alto, Calif. Research Lab.
DEVELOPMENT OF MANUFACTURING PROCESS FOR LARGE-DIAMETER COMPOSITE MONOFILAMENTS BY PYROLYSIS OF RESIN-IMPREGNATED CARBON-FIBER BUNDLES
W. G. Bradshaw, P. C. Pinoli, and A. E. Vidoz [1972] 112 p refs
(Contract NAS3-15552)
(NASA-CR-120973; LMSC-D309742) Avail: NTIS HC $7.75 CSCL 13H

Large diameter, carbon-carbon composite, monofilaments were produced from the pyrolysis of organic precursor resins reinforced with high-strenght carbon fibers. The mechanical properties were measured before and after pyrolysis and the results were correlated with the properties of the constituents. The composite resulting from the combination of Thornel 75 and GW-173 resin precursor produced the highest tensile strength. The importance of matching strain-to-failure of fibers and matrix to obtain all the potential reinforcement of fibers is discussed. Methods are described to reduce, within the carbonaceous matrix, pyrolysis flaws which tend to reduce the composite strength. Preliminary studies are described which demonstrated the feasibility of fiber-matrix copyrolysis to alleviate matrix cracking and provide an improved matrix-fiber interfacial bonding. Author

N73-21415# Defence Research Information Centre, Orpington (England).
VOLATILIZATION AND OXIDATION OF ELECTRODE METAL IN GAS-SHIELDED ARC WELDING

I. R. Patskevich et al Dec. 1972 10 p refs Transl. into ENGLISH from Avtomat. Svarka, (Kiev) v. 8, 1972 p 15-18
(DRIC-Trans-3005; BR-30371) Avail: NTIS HC $3.00

Volatilization and oxidation of electrode metal in arc welding affect the losses of the wire constituents, the size and behavior of liquid metal droplets at the electrode end, the arc stability, and the welding process. To obtain separate estimates of the quantities of electrode metal lost by volatilization and oxidation some experiments were carried out on a set equipped with devices for holding an electrode wire specimen and striking an arc, a thyristor current transformer, and an electronic time relay controlling the arcing time in the 0.01 to 2.0 sec interval. The arc was struck at a fixed gap between the specimen tip and a copper plate. The current, voltage, and arcing time were recorded on an oscillograph film. It was found that: the ratio of the quantity of volatilized electrode metal to the quantity of the fused metal increases with increasing current and arcing time; increasing the heat conductivity and oxidizing potential of the shielding gas increases the volatilization intensity; the quantity of volatilized and oxidized metal increases with increasing gas consumption; and the bulk of losses of electrode metal constituents is due to volatilization. ESRO

N73-21416# Defence Research Information Centre, Orpington (England).
ARGON ARC WELDING OF COPPER USING COMPLEX ALLOY WIRE
P. Slyshko Jan. 1973 8 p Transl. into ENGLISH from Avtomat. Svarka, (Kiev) v. 8, no. 221, 1971 1971 p 49-51
(DRIC-Trans-3008; BR-30374) Avail: NTIS HC $3.00

The results of the selection of special welding material for the argon arc welding of copper are presented. Three types of welding rods were tried: Cu-Si-Sn-Mn-B, Linde 372 (low-alloy material of the Cu-Si-Sn-Mn type), and Linde 911H (Cu-Ag-V). The wires were tested in manual argon arc welding of copper using tungsten electrodes, and in automatic and semi-automatic arc welding of smelted electrodes. Results show that the Cu-Si-Sn-Mn-B wire is satisfactory welding wire for use in manual arc welding of copper using tungsten electrodes. ESRO

N73-21417# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Munich (West Germany). Inst. fuer Flugtrieb- und Schmierstoffe.
SPECTROSCOPIC ANALYSIS OF METAL WEAR BASED ON TESTS OF AIRCRAFT TURBINE ENGINE OILS [UEBER DIE SPEKTROSKOPISCHE ANALYSE VON METALLABRIEB ANHAND VON OELUNTERSUCHUNGEN AUS FLUGTRIEBWERKEN]
Eilhard Jantzen 28 Nov. 1972 56 p refs In GERMAN; ENGLISH summary
(DLR-FB-73-06) Avail: NTIS HC $5.00; DFVLR, Porz, West Ger. 28,20 DM

Spectroscopic, photometric, and microscopic analyses were carried out to investigate metallic wear particles in 11 JT3D turbojet engines of a Boeing 707, with an aim to predicting engine damage. Emission and atom absorption spectrographs were used, and 9 elements were quantitatively detected, of which the quantities of iron, magnesium and silicon were in some cases more than 1 ppm, with a tendency to increase. Simultaneous light transmittance measurements show the influence of oil change, larger oil filling quantities and progressive oil consumption. Raster electron microscopy of abrasion particles was used to determine type, form, and size distribution of particles. ESRO

N73-21418# Centre de Recherches Scientifiques et Techniques de l'Industrie des Fabrications Metalliques, Brussels (Belgium). Mechanical Engineering Dept.
CONTINUOUS MEASUREMENT OF RESIDUAL STRESS IN THIN CYLINDRICAL PIECES USING DEFLECTION-ETCHING TECHNIQUES
Albert Decneut and Jacques Peters (Louvain Univ.) Jan. 1973 25 p refs Sponsored by IRSIA
(CRIF-MC-47) Avail: NTIS HC $3.25

In order to control residual stresses in cylindrical pieces, a continuous deflection-etching technique was developed. Throughout the design of the test set-up, special care was taken to obtain a maximum sensitivity and accuracy. The test equipment and practical procedure are described. The reproducibility of the method is checked and some typical stress plots are discussed. The results are very consistent. Author (ESRO)

N73-21419# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
BLADED MACHINES AND EJECTORS (CHAPTERS 1-5)
Yu. N. Vasiliev 19 Jan. 1973 128 p refs Transl. into ENGLISH from Lopatochnye Mashiny i Struynye Apparty (USSR), no. 5, 1971 p 175-261
(AD-755713; FTD-MT-24-1668-72) Avail: NTIS CSCL 13/11

The report describes the development of a theory of two-phase gas-liquid and liquid-gas ejectors with a cylindrical mixing chamber for the case where the vapor concentration in the mixture forming at the ejector outlet is negligibly small. The ejection equations, which give the relation backcurrent region can form near the flow core in the exit cone of a supersonic nozzle both in the case of a rotating gas flow and in the case of free swirling flow. The formation of such a region leads to a complex shock wave interaction pattern in the nozzle, which affects flow separation from the wall and the thrust characteristics of the nozzle. Author (GRA)

N73-21420# Iowa Univ., Iowa City. Dept. of Chemistry.
A STUDY OF THE EFFECT OF CORONA CONDITIONS ON ELECTROSTATIC PRINTING PROCESSES Final Technical Report
C. W. Frank and R. Buchacek Dec. 1972 64 p refs
(Contract DAAK02-72-C-0060; DA Proj. 4A6-62707-A-852)
(AD-755259; ETL-CR-72-17) Avail: NTIS CSCL 14/5

A study of those factors which can affect the quality of an electrostatic reproduction was undertaken. Observations were made under conditions which simulated the corona unit in Army electrostatic printers. The major areas of the study were: Corona configuration and charging homogeneity; and Environmental effect on the corona. The studies and conclusions have application to printing processes which employ corona discharge devices. The major recommendations involved the development of a process in which a positive wire charging configuration can be used, and development of a process which reduces the production of ozone in the unit. Author (GRA)

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid-State.

N73-21421 Rutgers Univ., New Brunswick, N.J.
THE EFFECT OF AN INTRACAVITY SATURABLE ABSORBER ON A SINGLE-MODE GAS LASER: A THEORETICAL STUDY Ph.D Thesis
Albert Mario Magro 1972 100 p
Avail: Univ. Microfilms Order No. 72-17852

Some of the operational properties of a gas laser which contains a saturable absorber within the resonator are described. The method of description is patterned closely after the classical theory of dispersion. There, the electromagnetic field along with the matter is treated classically. In the present case the radiation field is still treated classically, but the matter is treated as effective two state atoms which are described quantum mechanically. Dissert. Abstr.

N73-21422 Illinois Univ., Urbana.
CONSIDERATIONS IN LASER-EXCITED ATOMIC FLUORESCENCE SPECTROSCOPY AND RELATED INVESTIGATIONS Ph.D. Thesis
Medona Bonner Denton 1972 340 p
Avail: Univ. Microfilms Order No. 72-19818

Investigations are described for the use of a high power tunable organic dye laser as an excitation source for atomic fluorescence spectrometry. Theoretical implications and considerations are discussed showing that the tunable dye laser offers a tremendous increase in excitation power and efficiency with which the resulting power can be imaged on the flame. Experimental results from such a laser system are presented. Several configurations and modes of dye laser operation are experimentally investigated. The use of a tunable organic dye

laser as an excitation source for analytical atomic flame fluorescence in conjunction with ultrasonic nebulization is demonstrated. An analytical working curve for barium is given. Possible problems such as frequency jitter, power reproducibility, and multiple fine line structure emission were not found to preclude the use of this source to generate analytically-useful data. The theory and design of ultrasonic nebulizers are discussed.
Dissert. Abstr.

N73-21423*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
LASER SYSTEM OF EXTENDED RANGE Final Report
Carlton G. Lehr Dec. 1972 71 p refs
(Contract NASw-2014)
(NASA-CR-131513; Rept-212-085) Avail: NTIS HC $5.75 CSCL 20E

A pulsed laser system was developed for range measurements from the earth to retroreflecting satellites at distances up to that of the moon. The system has a transportable transmitter unit that can be moved from one location to another. This unit consists of a 0.2 m coude refractor and a high radiance, neodymium-glass, frequency doubled laser that operates in a single transverse mode. It can be used for lunar or distant satellite ranging at any observatory that has a telescope with an aperture diameter of about 1.5 m for the detection of the laser return pulses. This telescope is utilized in the same manner customarily employed for the observation of celestial objects. A special photometric package and the associated electronics are provided for laser ranging.
Author

N73-21424# Lockheed Missiles and Space Co., Palo Alto, Calif.
INVESTIGATION OF THE INVERSION MEDIUM OF A QUASISTATIONARY CO2 LASER WITH PULSE EXCITATION
I. F. Kanaev, E. P. Krugliakov, and V. K. Malinovskii [1972] 7 p refs Transl. into ENGLISH from Prikl. Mekh. i Tekhn. Fiz. (USSR), no. 1, 1973 p 23-29
Avail: NTIS HC $3.00, National Translations Center, John Crerar Library, Chicago, Ill. 60616

An investigation of the inversion medium of a quasi-stationary carbon dioxide laser was conducted. A characteristic of the excitation circuit is that the transit time of individual molecules across the discharge gap is less than the relaxation time of the carbon dioxide lasing level. The generation power, gain coefficient, saturation intensity, and gas temperature were measured. The distribution of the inversion medium molecules in the vibrational and rotational states is calculated.
Author

N73-21425*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
NASA HYDROGEN MASER ACCURACY AND STABILITY IN RELATION TO WORLD STANDARDS
Harry E. Peters and Donald B. Percival (US Naval Obs.) Apr. 1973 12 p refs
(NASA-TM-X-66229; X-524-73-109) Avail: NTIS HC $3.00 CSCL 20E

Frequency comparisons were made among five NASA hydrogen masers in 1969 and again in 1972 to a precision of one part in 10 to the 13th power. Frequency comparisons were also made between these masers and the cesium-beam ensembles of several international standards laboratories. The hydrogen maser frequency stabilities as related to IAT were comparable to the frequency stabilities of individual time scales with respect to IAT. The relative frequency variations among the NASA masers, measured after the three-year interval, were 2 + or - 2 parts in 10 to the 13th power. Thus time scales based on hydrogen masers would have excellent long-term stability and uniformity.
Author

N73-21426# Kanner (Leo) Associates, Redwood City, Calif.
PHOTOCHEMICAL IODINE LASER: KINETIC FOUNDATIONS FOR GIANT PULSE OPERATION
K. Hohla Nov. 1972 117 p refs Transl. into ENGLISH from West German Report IPP-4/33 Prepared for Sandia Labs. Sponsored by AEC
(SC-T-72-2560; IPP-4/33) Avail: NTIS

A gas laser which uses excited iodine atoms as the active material is described. The goal was to determine the potential of this laser for high power operation. A parameter of prime importance for the generation of giant pulses is the storage of energy in the amplifying medium. This is limited by two factors: uncontrolled oscillations and loss of inversion by chemical quenching deactivation. It is demonstrated that the effective linewidth can be broadened by inhomogeneous magnetic fields. The cross section sigma for stimulated emission was measured as a function of the CF3I pressure and the field strength by small- and large-signal gain measurements. Small signal gain measurements were also used to investigate the loss by collisions of excited iodine and, therefore, of the population inversion as a function of time. The deactivation rates found in this way show that no chemical limitations exist under the experimental conditions chosen for the storage of energy. The measurements also show the existence of a chemical pumping process in addition to the photolysis.
Author

N73-21427# California Univ., Livermore. Lawrence Livermore Lab.
LLL LASER PROJECTS
G. I. Kachen, Jr., ed. and G. Shaw, ed. Sep. 1972 18 p refs
(Contract W-7405-eng-48)
(UCRL-50022-3; Rept-3) Avail: NTIS

An optical system has been implemented for measuring the passive stress conditions in linear flash lamps. The concept was adopted from earlier work on locating and measuring stresses in electron tubes. It has been applied in the flash lamp study to provide a basis for determining the initial condition of the flash lamps before dynamic fatigue testing. The immediate benefit of the system is that it permits culling of potentially bad flash lamps and thereby reducing the number of premature explosions of lamps in laser heads, which can extensively damage the lasers. The availability of this technique will also permit the writing of specifications for flash lamps that include meaningful acceptance test procedures.
Author

N73-21428# Colorado Univ., Boulder. Dept. of Physics and Astrophysics.
CRITICAL SCATTERING OF LASER LIGHT BY THIN FLUID FILMS Progress Report
Richard Mockler and William OSullivan 1972 21 p refs
(Contract AT(11-1)-2203)
(COO-2203-1) Avail: NTIS

Results are presented of research conducted in the following areas: (1) Development of a closely spaced Fabry-Perot interferometer with flats separated by a thin fluid film for the purpose of studying the critical behavior of the effects of wall forces and confinement. (2) Development of internal reflection spectroscopic techniques for the purpose of measuring the critical parameters and the effects of wall forces on thin fluid films at the surface of an internal reflection element. (3) Development of techniques to study phenomena in fluids through the observation of scattered laser light from suspended Brownian particles.
Author

N73-21429# Bendix Corp., Kansas City, Mo.
TESTING FOR MATERIAL FLAWS AND THERMAL DESIGN DEFECTS USING HOLOGRAPHIC INTERFEROMETRY
M. C. Collins, M. P. Schoeppner, and C. E. Watterson Dec. 1972 27 p
(Contract AT(29-1)-613)
(BDX-613-812) Avail: NTIS

Holographic interferometry is used as a technique for nondestructive evaluation of internal voids and defects in materials, such as laminated and composite structures. A facility was assembled for performing experimental work. The experiments were designed to attain proficiency in all techniques used for holographic testing.
Author

N73-21430# California Univ., Livermore. Lawrence Livermore Lab.
LASER-FUSION PROGRAM Semiannual Report, Jan. - Jun. 1972
G. I. Kachen, Jr., ed., W. Clements, ed., and M. Genin, ed. 12 Jul. 1972 142 p refs
(Contract W-7405-eng-48)
(UCRL-50021-72-1; SAPR-2) Avail: NTIS

Research on the following topics is discussed: (1) Laser

research and development; (2) laser-produced plasmas; (3) diagnostics; and (4) laser fusion. NSA

N73-21431# Lyon Univ. (France). Inst. de Physique Nucleaire.
LASER ION SOURCE: SOME POSSIBILITIES FOR IMPROVEMENT
M. Bajard, A. Chabert, T. Tauth, A. Perez (CEA, Limeil-Brevannes, France), and G. Tonon (CEA, Limeil-Brevannes, France) Jul. 1972 11 p refs
(LYCEN-7253) Avail: AEC Depository Libraries

The characteristics of laser-produced plasmas are studied. Suggestions are made of how a beam could be formed from this sort of plasma. Phenomena such as time decoupling between ionic and electronic components, charge exchange processes and energy spread are analyzed. A system which could be used to produce pulses of highly charged ions having a duration of tens of microseconds and suitable for injection into heavy ion acclerators is described. NSA

N73-21432# Commissariat a l'Energie Atomique, Limeil-Brevannes (France). Centre d'Etudes.
GRAPHITE CONE CALORIMETERS FOR LASERS
J. L. Boutineau and R. Sauneuf 1964 8 p refs In FRENCH
Presented at 4th Natl. Meeting on Calorimetry and Differential Thermal Analysis, Paris, 4-5 May 1972)
(CEA-Conf-2056; Conf-720573-1) Avail: AEC Depository Libraries

Attempts were made to standardize measurements of laser beam absorption by graphite cones. Absorption was measured by a calorimeter and a series of thermocouples on the exterior of the cone, and thermocouples placed on another cone which served as a reference. The standardization was obtained by passing a transverse current energy pulse through the cone and comparing the results with the standard calorimeter. Results show the instrument's precision is on the order of 15 to 20%.
Transl. by E.H.W.

N73-21433# ARO, Inc., Arnold Air Force Station, Tenn.
PREDICTED MULTILINE CONTINUOUS WAVE POWER OUTPUT FROM A PERFECTLY STIRRED REACTOR CHEMICAL LASER Final Report, 1 Mar. - 30 Jun. 1972
I. T. Osgerby AEDC Feb. 1973 43 p refs
(AD-755904; ARO-ETF-TR-72-178; AEDC-TR-73-22) Avail: NTIS CSCL 20/5

The results of a previous study of the concept of a stirred reactor laser with lasing restricted to the zeroth fundamental band are compared with the predicted power output of a multilevel laser for the hydrogen-fluorine-helium (h2-F2-He) system. Lasing is assumed to occur on all fundamental bands for which the calculated maximum gain equals the cavity threshold value. Power output is significantly increased over the zeroth band calculations, and the effect of cavity pressure is shown to be less pronounced because of the cascade enhancement from higher bands. Vibrational de-excitation caused by collisional processes appears to limit this kind of chemical system to low cavity pressures. The effect of cavity losses was evaluated with three assumed values for the cavity loss coefficient. These values were estimated as a small fraction (0.1) of the average small signal gain coefficient at different cavity residence times. Author (GRA)

N73-21434# Washington Univ., St. Louis, Mo. Dept. of Electrical Engineering.
OPTIMIZATION OF THIN HOLOGRAPHIC DATA STORAGE SYSTEMS
Bernard Sander, Jr., William S. C. Chang, and Donald Snyder 10 Jun. 1972 206 p refs
(Contract F44620-69-C-0121; AF Proj. 7921)
(AD-755620; AFOSR-73-0024TR) Avail: NTIS CSCL 09/2

A procedure for optimization of holographic digital data storage systems is proposed and discussed. By optimization of the memory, is meant choosing the operating point of the memory either to maximize the capacity or to minimize the total read time. The operating point of the memory is defined by the number of holograms, the number of bits per page, the bias transmittance of the storage material, and the minimum beam balance ratio. The relationship of the number of holograms and the number of bits per page to the properties of the memory's components are determined. These numbers are limited in a complicated way by the minimum beam-balance ratio, which is the last parameter of the operating point to be specified. A model for the holographic process using thin holograms is proposed and analyzed. The model includes the optical diffusion, the nonlinearity of the transmittance-exposure curve, the random noise, and the diffraction-limit of the hologram aperture.
Author (GRA)

N73-21435# American Optical Co., Southbridge, Mass. Research Div.
MULTIPLE DOPED ERBIUM LASER MATERIALS Semiannual Report, 1 Oct. 1971 - 31 Mar. 1972
Richard F. Woodcock Jan. 1973 21 p refs
(Contract DAAB07-72-C-0053 ; ARPA Order 1464)
(AD-755683; TR-622-1; ECOM-0053-1) Avail: NTIS CSCL 20/5

The goal under this contract is to develop erbium doped laser glasses whose performance characteristics exceed those of previously developed erbium doped materials. One approach is to optimize the laser rod configuration. The effect of laser rod length on laser threshold and efficiency is reported. Consideration was given to the Double-U laser rod which should provide more efficient coupling preliminary results are discussed. A second approach is to develop high purity phosphated core and cladding glasses which combine the higher oscillator strength of the phosphate glasses with the improved sensitization technique of incorporating the sensitization agent in the cladding material. Efforts toward obtaining these high purity phosphate glasses, fabrication problems of clad rods, sensitization of the cladding and determination of core and cladding compatibility are discussed. Author (GRA)

N73-21436# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
NONLINEAR PULSE INTERACTION IN CO2 LASERS Final Technical Report, 15 Nov. 1969 - 30 Sep. 1972
Herman A. Haus 7 Nov. 1972 48 p refs
(Contract F19628-70-C-0064; AF Proj. 4645)
(AD-755919; AFCRL-72-0709) Avail: NTIS CSCL 20/5

Contents: High-repetition rate low-pressure laser; Spontaneous mode locking in TEA lasers; Negative saturation; Mode locking and cavity dumping; Parametric studies of the CO2 laser; Cross relaxation in a low-pressure CO2 cell; Instantaneous frequency measurement of the TEA laser. GRA

N73-21437# Naval Research Lab., Washington, D.C.
HIGH ENERGY LASER WINDOWS
31 Dec. 1972 86 p refs
(ARPA Order 2031)
(AD-755716; SAR-2) Avail: NTIS CSCL 20/5

The goal of the program is to improve the strength and fracture behavior of alkali halides while retaining their low absorption for laser window use. The approach of plastically deforming single cyrstals press forging to obtain a fine grain polycrystalline body has been previously shown to increase yield stresses by an order of magnitude (to about 5000 psi). In the report, further advances in raising strengths and lowering absorption are presented. GRA

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N73-21438 National Lending Library for Science and Technology, Boston Spa (England).
TECHNICAL AND ECONOMIC PROBLEMS AND POSSIBILITIES OF DEVELOPING TITANIUM POWDER METALLURGY
V. S. Ustinov, V. S. Lobanov et al 20 Dec. 1972 10 p refs
Transl. into ENGLISH from Tsvetn. Metal. (Moscow), v. 43, no. 8, Aug. 1970 p 73-76 In ENGLISH and RUSSIAN
(NLL-LTI-746-1336-(9022.401)) Avail: Natl. Lending Library, Boston Spa, Eng.: 1 NLL photocopy coupon

Methods of producing titanium powders are discussed in terms of technical and economic obstacles. Emphasis is placed on three such methods: reduction of titanium from its dioxide; hydrogenation of titanium or its wastes with subsequent dehydrogenation and refining; and electrolysis with dissolved anode from titanium wastes. It was found that by powder metallurgy methods it is possible to simplify the technique for preparing filler electrode material for welding titanium. J.M.M.

N73-21439 National Lending Library for Science and Technology, Boston Spa (England).
DETERMINATION OF GAS CONTENT IN CARBONYL NICKEL
V. I. Nedashkovskii, A. V. Revyakin, and A. M. Samarin 20 Dec. 1972 8 p refs Transl. into ENGLISH from Zavodsk. Lab. (Moscow), v. 38, no. 3, 1972 p 293-294 In ENGLISH and RUSSIAN
(NLL-LTI-746-1353-(9022.401)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The gas content of carbonyl nickel was studied in the following method: the total volume of gas extracted by the vacuum-melting method was determined on an exhalograph by pressure measurement; hydrogen was determined by measurement of thermal conductivity; carbon dioxide by infrared absorption; and nitrogen by the residual difference. Collaterally, the results of gas content determination using a crucible with a cover at various temperatures showed that as the temperature increases, the observed value of the oxygen content increases, while that of nitrogen decreases, indicating the reduction of carbon dioxide by graphite. Under identical conditions hydrogen content remains at the same level. With temperatures in excess of 1800 C complete reduction of carbon dioxide occurs. J.M.M.

N73-21440 National Lending Library for Science and Technology, Boston Spa (England).
CONCENTRATION DEPENDENCE OF HIGH-FIELD SUSCEPTIBILITY OF Fe-Ni (AND Ni-Fe) ALLOYS
V. E. Rode and I. B. Krynetskaya 20 Dec. 1972 6 p refs Transl. into ENGLISH from Fiz. Tverd. Tela (Leningrad), v. 14, no. 2, 1972 p 625-626 In ENGLISH and RUSSIAN
(NLL-LTI-746-1343-(9022.401)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The paraprocess susceptibility of iron-nickel alloy at 4.2 K was measured in samples, in which the nickel content was varied from 0 to 100%. The measurements were conducted by the induction method in a superconductive solenoid in magnetic fields up to 50 Koersted. A sharp increase in the paraprocess susceptibility was observed in the region of about 30 at. % nickel in iron. Author

N73-21441*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
A MECHANICAL PROPERTY AND STRESS CORROSION EVALUATION OF 431 STAINLESS STEEL ALLOY
J. W. Montano 7 Mar. 1973 38 p refs
(NASA-TM-X-64729) Avail: NTIS HC $4.00 CSCL 11F

The mechanical properties of type 431 stainless steel in two conditions: annealed bar and hardened and tempered bar are presented. Test specimens, manufactured from approximately 1.0 inch (2.54 cm) diameter bar stock, were tested at temperatures of 80 F (+26.7 C), 0 F (-17.8 C), -100 F (-73 C), and -200 F (-129 C). The test data indicated excellent tensile strength, notched/unnotched tensile ratio, ductility, shear, and impact properties at all testing temperatures. Results of the alternate immersion stress corrosion tests on stressed and unstressed longitudinal tensile specimens 0.1250 inch (0.3175 cm) diameter and transverse C-ring specimens, machined from 1.0 inch (2.54 cm) diameter bar stock, indicated that the material is not susceptible to stress corrosion cracking when tested in a 3.5 percent NaCl solution for 180 days. Author

N73-21442*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
GAS-PHASE HYDROGEN PERMEATION THROUGH ALPHA IRON, 4130 STEEL, AND 304 STAINLESS STEEL FROM LESS THAN 100 C TO NEAR 600 C
Howard G. Nelson and James E. Stein Washington Apr. 1973 21 p refs
(NASA-TN-D-7265; A-4749) Avail: NTIS HC $3.00 CSCL 11F

Gas phase hydrogen permeation studies were conducted on hollow, cylindrical membranes of triply zone-refined alpha iron, AISI 304 austenitic stainless steel, and AISI-SAE 4130 steel in both the normalized (ferrite and carbide) and quenched and tempered (martensite) conditions. Membrane temperature was varied from less than 100 C to near 600 C and hydrogen pressure was varied. For one membrane material, normalized 4130 steel, gas phase hydrogen transport under both steady state and nonsteady state conditions was demonstrated to be controlled by lattice diffusion. Additionally, Sievert's law was shown to be applicable. For all membrane materials, expressions for the coefficients for hydrogen permeation were determined by analysis of steady state transport; the coefficients for diffusion were determined by the lag time technique applied to nonsteady state transport; and through a knowledge of the Sievert's constants, the subsurface equilibrium lattice hydrogen concentrations were determined. Author

N73-21443*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SOLID-STATE AND FUSION RESISTANCE SPOT WELDING OF TD-NiCr SHEET
Thomas J. Moore Washington Apr. 1973 35 p refs
(NASA-TN-D-7256; E-7311) Avail: NTIS HC $3.00 CSCL 11F

By using specially processed TD-NiCr sheet in both 0.4-mm (0.015-in.) and 1.6-mm (0.062-in.) thicknesses and carefully selected welding procedures, solid state resistance spot welds were produced which, after postheating at 1200 C, were indistinguishable from the parent material. Stress-rupture shear tests of single-spot lap joints in 0.4-mm (0.015-in.) thick sheet showed that these welds were as strong as the parent material. Similar results were obtained in tensile-shear tests at room temperature and 1100 C and in fatigue tests. Conventional fusion spot welds in commercial sheet were unsatisfactory because of poor stress-rupture shear properties resulting from metallurgical damage to the parent material. Author

N73-21444*# Rocketdyne, Canoga Park, Calif.
HYDROGEN ENVIRONMENT EMBRITTLEMENT OF METALS
R. P. Jewett, R. J. Walter, W. T. Chandler, and R. P. Frohmberg Washington Mar. 1973 241 p refs
(Contract NAS8-19(C))
(NASA-CR-2163) Avail: NTIS HC $3.00 CSCL 11F

Hydrogen environment embrittlement refers to metals stressed while exposed to a hydrogen atmosphere. Tested in air, even after exposure to hydrogen under pressure, this effect is not observed on similar specimens. Much high purity hydrogen is prepared by evaporation of liquid hydrogen, and thus has low levels for potential impurities which could otherwise inhibit or poison the absorbent reactions that are involved. High strength steels and nickel-base allows are rated as showing extreme embrittlement; aluminum alloys and the austenitic stainless steels, as well as copper, have negligible susceptibility to this phenomenon. The cracking that occurs appears to be a surface phenomenon, is unlike that of internal hydrogen embrittlement. Author

N73-21445# Joint Publications Research Service, Arlington, Va.
SELECTED TRANSLATIONS ON METALLURGY
19 Mar. 1973 35 p refs Transl. into ENGLISH from Izv. AN SSSR, Metally (Moscow), no. 1, 1973
(JPRS-58508) Avail: NTIS HC $3.75

Metallurgical processes are investigated regarding the interaction of oxygen and nitrogen with melts during plasma arc conditions, the creep properties of nickel and binary alloys, and the use of the Mossbauer effect to study the diffusion mechanism of iron in beta-titanium. For individual titles, see N73-21446 through N73-21449.

N73-21446 Joint Publications Research Service, Arlington, Va.
CHARACTERISTIC FEATURES OF THE INTERACTION OF OXYGEN-CONTAINING MIXTURES WITH REFRACTORY

METAL MELTS DURING PLASMA-ARC PROCESSES
V. I. Kashin, Ye. L. Klibanov, A. G. Tsilosani, V. G. Semenov, and N. I. Vinogradov *In its* Selected Transl. on Met. 19 Mar. 1973 p 1-14 refs (For availability see N73-21445 12-17)

The study of the kinetic and thermodynamic laws of the conversion of oxygen from the gas phase to a metal was carried out on a specially built device for melting refractory metals in a controlled atmosphere using a gas-stabilized electric arc. The metal temperature was measured at the time of exclusion of the arc by a photoelectric pyrometer and recorded on a standard movie film. It was established that the maximum rate of conversion of oxygen in molybdenum and tungsten takes place at the beginning of holding. Author

N73-21447 Joint Publications Research Service, Arlington, Va.
INTERACTION OF THE NITROGEN OF THE FURNACE ATMOSPHERE WITH AN ARGON PLASMA ARC c25
O. F. Aksenov, V. M. Antipov, R. S. Bobrovskaya, M. M. Krutyanskiy, and G. N. Okorokov *In its* Selected Transl. on Met. 19 Mar. 1973 p 15-21 refs (For availability see N73-21445 12-17)

The mass exchange of nitrogen between a furnace atmosphere and an argon arc when melting pure iron in a plasma arc furnace was investigated. An influx of nitrogen from the furnace atmosphere into the plasma arc was determined and attributed to the pressure gradient in the column caused by the electromagnetic forces and the solution of the nitrogen in the metal in the anode spot zone. In addition, it was found that the amount of nitrogen entering the argon plasma arc and the metal from the furnace atmosphere is determined by the partial pressure of the nitrogen, the current strength, and the flow rate of the plasma-forming gas. J.M.M.

N73-21448 Joint Publications Research Service, Arlington, Va.
CREEP OF NICKEL AND ITS SOLID SOLUTIONS AT INCREASED TEMPERATURES
L. N. Guseva and I. V. Egiz *In its* Selected Transl. on Met. 19 Mar. 1973 p 22-27 refs (For availability see N73-21445 12-17)

The effect of Al, Cr, Nb, Mo, and W on the steady-state creep rate of nickel was studied at the temperature of T (creep) = 0.66 T (melt). For nickel alloys with Cr and Mo a study was also made of the temperature dependence of the Young's modulus. The binary alloys were made from highly pure materials in a high frequency vacuum furnace, and were all homogeneous equilibrium solid solutions. It was found that the steady-state creep rate in nickel and its binary solid solutions correlate well with the principles of packing defect energy. J.M.M.

N73-21449 Joint Publications Research Service, Arlington, Va.
APPLICATION OF THE MOESSBAUER EFFECT TO STUDY THE DIFFUSION MECHANISM OF IRON IN BETA TITANIUM
A. N. Alleshin, B. S. Bokshtein, and G. S. Nikolkiy *In its* Selected Transl. on Met. 19 Mar. 1973 p 28-33 refs (For availability see N73-21445 12-17)

Measurements of the Mossbauer absorption spectra were made on a single channel device in the constant velocity mode with a scintillation detector. It was found that with an increase in the Fe content in beta-Ti the density of the s-electrons in the Fe nucleus decreases. The relation between the diffusion activation energy of the admixed Fe atoms and the density of the s-electrons in the Fe nucleus is opposite to the relation which is correct for the vacancy mechanism of diffusion. Further, the possibility of Fe diffusion in a dilute beta-Ti solution by the intersite mechanism is discussed. Author

N73-21450*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AN EXPERIMENTAL INVESTIGATION OF THE EFFECTS OF VACUUM ENVIRONMENT ON THE FATIGUE LIFE, FATIGUE-CRACK-GROWTH BEHAVIOR, AND FRACTURE TOUGHNESS OF 7075-T6 ALUMINUM ALLOY Ph.D. Thesis - North Carolina State Univ.
Charles Michael Hudson 1972 167 p refs
(NASA-TM-X-69223) Avail: NTIS HC $10.50 CSCL 11F

Axial load fatigue life, fatigue-crack propagation, and fracture toughness tests were conducted on 0.090-inch thick specimens made of 7075-T6 aluminum alloy. The fatigue life and fatigue-crack propagation experiments were conducted at a stress ratio of 0.02. Maximum stresses ranged from 33 to 60 ksi in the fatigue life experiments, and from 10 to 40 ksi in the fatigue-crack propagation experiments, and fatigue life experiments were conducted at gas pressures of 760, 0.5, 0.05, and 0.00000005 torr. Fatigue-crack-growth and fracture toughness experiments were conducted at gas pressures of 760 and 5 x 10 to the minus 8th power torr. Residual stress measurements were made on selected fatigue life specimens to determine the effect of such stresses on fatigue life. Analysis of the results from the fatigue life experiments indicated that fatigue life progressively increased as the gas pressure decreased. Analysis of the results from the fatigue-crack-growth experiments indicates that at low values of stress-intensity range, the fatigue crack growth rates were approximately twice as high in air as in vacuum. Fracture toughness data showed there was essentially no difference in the fracture toughness of 7075-T6 in vacuum and in air. Author

N73-21451# National Bureau of Standards, Boulder, Colo. Cryogenics Div.
LORENZ RATIOS OF TECHNICALLY IMPORTANT METALS AND ALLOYS
J. G. Hust and L. L. Sparks Feb. 1973 133 p refs
(NBS-TN-634) Avail: SOD $1.25 as C13.46:634

A review and compilation of the world literature on Lorenz ratio of technically important metals and alloys is presented. Lorenz ratio, electrical resistivity, thermal conductivity and characterization data are compiled in tabular form and the Lorenz ratio data are presented in graphical form as well. Data are included here only if the research reported both thermal conductivity and electrical resistivity of the specimens. No attempt has been made to smooth data or present recommended values. Author

N73-21452*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A MATERIAL SELECTION METHOD BASED ON MATERIAL PROPERTIES AND OPERATING PARAMETERS
Wolf Elber and John R. Davidson Washington Apr. 1972 12 p refs
(NASA-TN-D-7221; L-8589) Avail: NTIS HC $3.00 CSCL 20K

The influence of strength, fracture toughness, and crack growth resistance on the design stress level has been determined from a mathematical model of crack growth and failure. The results show that to select materials properly, the operating parameters of desired life and initial flaw size must be considered simultaneously with the material properties. To do this, a method for constructing an operating surface is derived, discussed, and illustrated. Author

N73-21453*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECT OF SPECIMEN THICKNESS OF FATIGUE-CRACK-GROWTH BEHAVIOR AND FRACTURE TOUGHNESS OF 7075-T6 AND 7178-T6 ALUMINUM ALLOYS
C. Michael Hudson and J. C. Newman, Jr. Washington Apr. 1973 32 p refs
(NASA-TN-D-7173; L-8731) Avail: NTIS HC $3.00 CSCL 11F

A study was made to determine the effects of specimen thickness on fatigue crack growth and fracture behavior of 7075-T6 and 7178-T6 aluminum alloy sheet and plate. Specimen thicknesses ranged from 5.1 to 12.7 mm (0.20 to 0.50 in.) for 7075-T6 and from 1.3 to 6.4 mm (0.05 to 0.25 in.) for 7178-T6. The stress ratios R used in the crack growth experiments were 0.02 and 0.50. For 7075-T6, specimen thickness had relatively little effect on fatigue-crack growth. However, the fracture toughness of the thickness of the thickest gage of 7075-T6 was about two-thirds of the fracture toughness of the thinner gages of 7075-T6. For 7178-T6, fatigue cracks generally grew somewhat faster in the thicker gages than in the thinnest gage. The fracture toughness of the thickest gage of 7178-T6 was about two-thirds of the fracture toughness of the thinner gages of 7178-T6. Stress intensity methods were used to analyze the

experimental results. For a given thickness and value of R, the rate of fatigue crack growth was essentially a single-valued function of the stress intensity range for 7075-T6 and 7178-T6. An empirical equation developed by Forman, Kearney, and Engle fit the 7075-T6 and 7178-T6 crack growth data reasonably well. Author

N73-21454*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

FORMATION AND BREAKDOWN OF A PROTECTIVE LAYER OF CHROMIUM SESQUIOXIDE ON L-605 ALLOY AT 1100 C

Carl E. Lowell and Daniel L. Deadmore Washington Apr. 1973 17 p refs

(NASA-TN-D-7255; E-7322) Avail: NTIS HC $3.00 CSCL 11F

The formation and breakdown of a protective layer of Cr_2O_3 on the cobalt-base alloy L-605 during oxidation at 1100 C was evaluated. Deformed surface layers, pressure, and moisture were variables. Increasing surface deformation, decreasing pressure, and decreasing moisture increased time to breakdown. A model was deduced. The breakdown of the Cr_2O_3 layer was caused by a combination of growth stresses and volatilization. Breakdown exposed a chromium-depleted alloy to air, resulting in very rapid oxidation, which continued until consumption of the depletion zone was complete. Author

N73-21455# Joint Publications Research Service, Arlington, Va.

INVESTIGATION OF THE DIFFRACTION OF X-RAYS IN AGING ALLOYS HAVING A DIFFERENT DEGREE OF VOLUMETRIC DISCREPANCY BETWEEN THE PRECIPITATION PHASE AND THE MATRIX

M. I. Gitgarts and V. V. Ivashin 17 Apr. 1973 10 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 202, no. 4, 1972 p 807-810

(JPRS-58761) Avail: NTIS HC $3.00

The diffraction of X-rays in aging alloys having a different degree of volumetric discrepancy between the precipitation phase and the matrix is studied. Author

N73-21456# Joint Publications Research Service, Arlington, Va.

PHASE COMPOSITION OF Ni-Sn ALLOYS HARDENED FROM THE LIQUID STATE

A. F. Polesya and L. S. Slipchenko 6 Apr. 1973 10 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Tsvetn. Met. (Dzaudzhikau), no. 3, 1972 p 128-133

(JPRS-58681) Avail: NTIS HC $3.00

An analysis of the structure of rapidly crystallizing alloys basically in the range of compositions corresponding to the two-phase states in equilibrium, is presented. Author

N73-21457*# Philco-Ford Corp., Newport Beach, Calif. Aeronutronic Div.

FURTHER DEVELOPMENT AND CHARACTERIZATION OF VM-103, A NASA WROUGHT COBALT BASE ALLOY Contractor Report

R. A. Harlow and E. E. Ritchie 15 Dec. 1972 55 p refs (Contract NAS3-14329)

(NASA-CR-121189) Avail: NTIS HC $4.75 CSCL 11F

The data obtained during this and previous programs indicate that the VM-103 has useful strength at temperatures as high as 2200 F (1204 C), and can be considered as an alternate for other wrought superalloys such as L-605. The addition of 10 percent nickel to the standard composition improves both the hot and cold fabricability, ductility, impact strength, and metallurgical stability, while it only slightly reduces strength properties. Electroslag remelting was effective in significantly increasing the fabricability of vacuum induction method VM-103, both with and without the 10 percent nickel addition. A specification for wrought VM-103 was developed and is included. Although thermomechanical processing improves lower temperature properties, no improvement occurs at temperatures at or above 2000 F (1093 C). Author

N73-21458# Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant.

INFILTRATION OF METALLOGRAPHIC SPECIMENS WITH METALLIC ALLOYS

E. T. Rose and L. F. DeRoos 18 Oct. 1972 14 p refs (Contract W-7405-eng-26)

(Y-1846) Avail: NTIS CSCL 11F

A simplified technique was devised for infiltrating porous and particulate materials with a metallic alloy for metallographic processing. This technique was found suitable for processing production quantities of metallographic specimens for microexamination and electron microprobe analysis. Author (NSA)

N73-21459# Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant.

BOND ADHESION STUDY OF ELECTROLESS NICKEL PLATING ON TYPE 4340 STEEL

C. A. Reeves, Jr. 8 Nov. 1972 25 p (Contract W-7405-eng-26)

(Y-1838) Avail: NTIS

A study has been made of the adhesion strength of electroless nickel plating on Type 4340 steel. This study had a two-fold purpose: (1) to determine the optimum plating conditions, and (2) to find a new test method to certify the bond strength. Specimens which had received a pretreatment by different procedures were plated in order to ascertain this effect on plating adhesion. Adhesion strength was determined by tensile testing these specimens and determining the relative plating adhesion from the total area of plating flake off and the average number of crazing lines per linear inch. The test method has proved to be satisfactory. Author

N73-21460# Oak Ridge Y-12 Plant, Tenn.

EFFECT OF HEAT TREATMENT ON METALLURGICAL AND MECHANICAL PROPERTIES OF WELD METAL IN A LEAD-0.06 WEIGHT PERCENT CALCIUM ALLOY M.S. Thesis - Tenn. Univ., Knoxville

W. W. Canary 29 Sep. 1972 110 p refs (Contract W-7405-eng-26)

(Y-1855) Avail: NTIS

An investigation was conducted to determine the welding parameters necessary to produce a metallurgically sound weld with chemistry similar to the 0.06 weight percent calcium base metal and to assess the effect of heat treatment on metallurgical and mechanical properties of the weld metal and heat-affected zone. The gas-tungsten arc alternating current welding process was used. The process permitted the addition of filler metal, promoted complete fusion, and resulted in a smooth weld bead. The weld metal was determined to respond in a manner similar to base metal when similarly heat treated and aged. Author

N73-21461# Oak Ridge National Lab., Tenn.

THE Ni-61 MOESSBAUER EFFECT IN NICKEL-PALLADIUM ALLOYS Ph.D. Thesis - Tenn. Univ.

John E. Tansil Aug. 1972 84 p refs Sponsored by AEC

(TID-26197) Avail: NTIS

The 67.4 keV transition from Ni-61 was used to obtain Moessbauer absorption spectra with Ni-Pd alloy absorbers throughout the concentration range 0-99.5 at. percent Pd. The source contained the parent isotope Co-61, produced by the reaction Ni-61 (P, alpha) Co-61, in a nonmagnetic N1-64 V (14 at. percent) foil. Both source and absorber were immersed in liquid helium. In the ferromagnetic region 0-98 at. percent Pd, the spectra showed a partly resolved magnetic hyperfine splitting with a distribution of magnetic hyperfine fields. For each absorber a value was obtained for the Ni-61 recoilless fraction, energy shift, absolute value of the hyperfine field, and second moment of the magnetic field distribution. The Ni-61 average hyperfine field is negative in pure Ni (-76 KOe), changes sign near 50 at. percent Pd, and rises to a large positive value (+173 KOe) at 90 at. percent Pd. Qualitative agreement with these results is obtained. Author

N73-21462# Sandia Labs., Albuquerque, N.Mex.

CHARACTERISTICS OF ACOUSTIC EMISSION SIGNALS GENERATED BY A PHASE TRANSITION

A. G. Beattie [1972] 10 p refs Presented at Conf. on Sonics and Ultrasonics, Boston, Mass., 4 Oct. 1972 Sponsored by AEC

(SC-DC-72-1650; Conf-721022-1) Avail: NTIS

Studies were made of the acoustic emission signals generated by the fcc to fct phase transition in the alloy In 23 at. Percent Tl. The total detected energy was measured as a function of both polarization and wave propagation direction with respect to the plane of transformation of the sample. The frequency content of the emission signals was also measured as a function of direction and polarization. The results put definite limitations on the types of mechanisms which could generate these signals. Author

N73-21463# Addis Translations International, Woodside, Calif.
SIMPLIFIED METHOD FOR DETERMINING THE COEFFICIENT OF DIFFUSION OF HYDROGEN IN SOLID METALS
Werner Dresler and Martin G. Frohberg 1972 15 p refs
Transl. into ENGLISH from Z. Metallk. (Stuttgart), v. 63, no. 4, 1972 p 204-209 Prepared for Calif. Univ., Livermore. Lawrence Livermore Lab. Sponsored by AEC
(UCRL-Trans-10651) Avail: NTIS

A simplified method for the determination of the diffusion coefficient of gases through membranes, which is based on the knowledge of the behavior of the permeation current vs time curve at the point of inflexion, is described. This method was tested experimentally by applying it to the case of hydrogen diffusion through pure nickel and an iron-nickel alloy. The simplification of the evaluation process permits a significant rationalization of the test method as well as a more accurate determination of the diffusion coefficient. This latter effect is due to the fact that undesired perturbations after prolonged duration of the test may be eliminated. Author (NSA)

N73-21464# Atomic Energy of Canada Ltd., Chalk River (Ontario). Nuclear Labs.
ON BUBBLE STRENGTHENING OF ZIRCONIUM ALLOYS
E. M. Schulson Sep. 1972 24 p refs
(AECL-4252) Avail: AEC Depository Libraries; Atomic Energy of Can., Ltd., Chalk River: $1.00

A theoretical analysis is presented which considers the strengthening of Zr alloys in creep through the interaction of mobile dislocations and gas bubbles. By introducing small amounts of the elements Be(9), Li(6) or B(10). He gas can be produced during neutron irradiation via the (n alpha) transmutation reactions. The questions discussed in the report are: (1) can He bubbles be produced during irradiation in a typical CANDU flux at temperatures between 300 C and 450 C; (2) if so, what will be their expected size and number density; and (3) what size and number density will probably be required to reduce the creep rate to 10 to the minus 7th power per hour? The calculations indicate that bubbles could form, but that the amount of gas likely to be produced may not be large enough to impart the desired strengthening. Author (NSA)

N73-21465# Naval Research Lab., Washington, D.C. Metallurgy Div.
DYNAMIC TEAR TESTS OF 3 INCH THICK ALUMINUM ALLOYS Final Report on Phase 1
Ralph W. Judy, Jr. and Robert J. Goode 29 Jan. 1973 19 p refs
(AD-755436; NRL-7538) Avail: NTIS CSCL 11/6

The Dynamic Tear (DT) test was developed for characterization of the fracture-resistance properties of metals over the entire range of strength and toughness. The fracture-extension-resistance curve (R curve), which is determined by DT test procedures, indicates the fracture state (elastic or plastic) and the level of resistance to crack extension in terms of the required energy per unit extension. R curves were determined for four aluminum alloys in 3-in. thicknesses. These materials have been tested by standard fracture-mechanics procedures. R curves for full thickness and for 1-in. and 0.625-in. section sizes are compared to results of K(Ic) tests. The R-curve data are also presented in terms of an equation involving specimen cross-section dimensions and a constant which is related to the R-curve slope. Author (GRA)

N73-21466# Air Force Materials Lab., Wright-Patterson AFB, Ohio.
EMERGING AEROSPACE MATERIALS AND FABRICATION TECHNIQUES
Albert Olevitch Sep. 1972 112 p refs
(AF Proj. 7381)
(AD-755371; AFML-TR-72-118) Avail: NTIS CSCL 11/6

Some of the more promising aerospace materials and fabrication techniques resulting from recent research and development programs of the Air Force Materials Laboratory are briefly described. These materials include metals and alloys, seals and sealants, coatings and finishes, fibers and filaments, resins and adhesives, ablation materials, graphites, fluids and lubricants, and miscellaneous materials. Proven or potential applications, limitations, and availability of the materials are described. The report is intended to provide a consolidated review of promising materials for selection for improved and future aerospace systems. Author (GRA)

N73-21467# Martin Marietta Corp., Denver, Colo.
THE EFFECT OF SURFACE LAYER STRESS ON PLASTIC DEFORMATION AND CRACK PROPAGATION Semiannual Report, Jul. - Dec. 1972
Irving R. Kramer Dec. 1972 30 p
(Contract DAAG46-70-C-0102)
(AD-755844; AMMRC-CR-71-2/5) Avail: NTIS CSCL 11/6

The relationship between the increase in the surface layer stress and number of fatigue cycles was established for 4130 steel (yield strength = 180,000 psi). Confirming the results found for aluminum (2014-T6) and titanium (6Al-4V), fatigue failure occurred when the surface layer stress attained a critical value. The crack propagation rate was measured for 4130 steel at yield strengths of 180,000 and 100,000 psi. The results showed that the SLE treatment improved the crack resistance. Pressure vessels of 4130 steel have been obtained and processed for fatigue testing. Welded specimens of 4130 steel have been made by butt-welding plates and machining out appropriate strips. The microstructure and hardness profile were determined and the specimens readied for test. A four-point fatigue apparatus and associated mechanism for detecting fatigue failure was designed and constructed. Author (GRA)

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N73-21468 National Lending Library for Science and Technology, Boston Spa (England).
INVESTIGATION OF SOLID-PHASE INTERACTION IN COBALT-CARBIDE SYSTEMS
E. M. Petrova and N. I. Shcherban 20 Dec. 1972 13 p refs
Transl. into ENGLISH from Poroshkovaya Met., Akad. Nauk Ukr. SSR (Kiev), no. 1, 1972 p 35-40 In ENGLISH and RUSSIAN
(NLL-LTI-746-1338-(9022.401))

The kinetics of growth of the diffusion layer thickness during interaction of titanium, zirconium, niobium, chromium, molybdenum, and tungsten carbides with cobalt were studied. It was found that a diffusion reaction is observed in the investigated systems with an increase in temperature. It was shown that the parameters n and Q (constant for given pair of interacting materials and activation energy, respectively), characterizing the diffusion reaction process, correlate with the thermodynamic characteristics of the carbides: the higher their thermodynamic stability, the higher the values of n and Q.
Author

N73-21469*# North American Rockwell Corp., Downey, Calif.
THERMAL DESIGN OF COMPOSITE MATERIAL HIGH TEMPERATURE ATTACHMENTS Progress Report
6 Feb. 1972 59 p
(Contract NAS8-27041)
(NASA-CR-124206; PR-9; QPR-3) Avail: NTIS HC $5.00 CSCL 11D

An evaluation has been made of the thermal aspects of utilizing advanced filamentary composite materials as primary structures on the shuttle vehicle. The technical objectives of this study are to: (1) establish and design concepts for maintaining material temperatures within allowable limits at TPS attachments

and or penetrations applicable to the space shuttle; and (2) verify the thermal design analysis by testing selected concepts. Specific composite materials being evaluated are boron epoxy, graphite/epoxy, boron polyimide, and boron aluminum; graphite/polyimide has been added to this list for property data identification and preliminary evaluation of thermal design problems. The TPS standoff to composite structure attachment over-temperature problem is directly related to TPS maximum surface temperature. To provide a thermally comprehensive evaluation of attachment temperature characteristics, maximum surface temperatures of 900 F, 1200 F, 1800 F, 2500 F and 3000 F are considered in this study. This range of surface temperatures and the high and low maximum temperature capability of the selected composite materials will result in a wide range of thermal requirements for composite/TPS standoff attachments. Author

N73-21470*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
URANIUM NITRIDE BEHAVIOR AT THERMIONIC TEMPERATURES
W. M. Phillips 1 Apr. 1973 22 p refs
(Contract NAS7-100)
(NASA-CR-131520; JPL-TM-33-602) Avail: NTIS HC $3.25 CSCL 11D

The feasibility of using uranium nitride for in-core thermionic applications was evaluated in electrically heated thermal gradient tests and in flat plate thermionic converters. These tests indicated that grain boundary penetration of uranium nitride into both tungsten and rhenium will occur under thermal gradient conditions. In the case of the tungsten thermionic converter, this led to grain boundary rupture of the emitter and almost total loss of electrical output from the converter. It appears that uranium nitride is unsuitable for thermionic applications at the 2000 K temperatures used in these tests. Author

N73-21471*# Hughes Aircraft Co., Canoga Park, Calif.
REFRACTORY PORCELAIN ENAMEL PASSIVE THERMAL CONTROL COATING FOR HIGH TEMPERATURE ALLOYS Patent Application
Herman Levin, Byron Auker, H., and Michael N. Gardos, inventors (to NASA) Filed 11 Apr. 1973 13 p
(Contract NAS8-27439)
(NASA-Case-MFS-22324-1; US-Patent-Appl-SN-350250) Avail: NTIS HC $3.00 CSCL 11C

A procelain enamel composition is described for coating high-temperature, nonferrous alloys to provide passive thermal control in the space environment, and which resists severe thermal cycling conditions encountered during reentry. The coating composition is comprised of a high-refractory-content boroaluminum silicate glass frit containing an amount of zirconium oxide exceeding frit solubility at smelting temperature, along with specified amounts of alkali and alkaline earth oxide flux, zinc oxide and fluoride, and a submicron disperse phase of cubic-stabilized zirconium oxide. The coatings also exhibit favorable optical properties for thermal control use, including a low solar absorptance and a high emittance. NASA

N73-21472*# Battelle Columbus Labs., Ohio.
AN EVALUATION OF UPGRADED BORON FIBERS IN EPOXY-MATRIX COMPOSITES Final Report
T. C. Rhodes, J. N. Fleck, and K. E. Meiners 26 Jan. 1973 16 p refs
(Contract NAS1-11589)
(NASA-CR-112266) Avail: NTIS HC $3.00 CSCL 11D

An initial evaluation of upgraded boron fibers in an epoxy matrix is performed. Data generated on the program show that fiber strength does increase as a consequence of the upgrading treatment. However, the interlaninar shear strength of upgraded fiber composites is lower than that for an untreated fiber composite. In the limited tests performed, the increased fiber strength failed to translate into the composite. Author

N73-21473# Marquette Univ., Milwaukee, Wis. Coll. of Engineering.
ELECTRICAL CONDUCTIVITY OF CaO-DOPED NONSTOICHIOMETRIC CERIUM DIOXIDE FROM 700 TO 1500 C
R. N. Blumenthal, F. S. Brugner, and J. E. Garnier 1972 38 p refs
(COO-1441-16) Avail: NTIS

The electrical conductivity of sintered specimens of CaO-doped CeO2 (0.1 to 16.0 mole %) was measured over the temperature range 700 to 1500 C and from 1 to 10 to the minus 22nd power atm of oxygen. All specimens of CaO-doped (CeO2 exhibited mixed conduction. Predominantly ionic conductivity was observed at low temperatures and high oxygen partial pressures. Conversely, high temperatures and lower oxygen partial pressures were dominated by electronic conductivity. Two limiting case regions were observed. At low temperatures and high oxygen pressures, the conductivity is predominantly ionic. In this region the conductivity is independent of Po2 and between approximately 1 and 8 mole % CeO is proportioned to mole % CaO. A thermodynamic argument is presented which favors oxygen vacancies as the nonstoichiometric defect in both pure and CaO-doped CeO2. Author (NSA)

N73-21474# Marquette Univ., Milwaukee, Wis. Coll. of Engineering.
TEMPERATURE DEPENDENCE OF THE ELECTRICAL CONDUCTIVITY OF NONSTOICHIOMETRIC CeO(2-x)
R. N. Blumenthal and R. L. Hofmaier 1972 32 p refs
(COO-1441-17) Avail: NTIS

The electrical conductivity of sintered specimens of nonstoichiometric CeO(2-x) was measured as a function of temperature from 1000 to 300 C and composition from 0.0042 less than or equal X less than or equal 0.178. Results were described in terms of a high temperature and low temperature region, in both regions, the conductivity for fixed values of x exhibits an exponential dependence on temperature. In the high temperature region, the activation energy increased with increasing values of x (i.e., 0.22 eV at x = 0.00424 to 0.37 eV at x = 0.178). The activation energy, 0.61 + or - 0.03 eV, in the low temperature region was independent of x. The temperature of the intersection between the high and low temperature regions for each composition was compared with the composition-temperature dependence of the miscibility gap reported by Brauer and Gingerich. Author (NSA)

N73-21475# Battelle-Northwest, Richland, Wash.
ELECTRICAL CONDUCTIVITY OF THORIUM DIOXIDE
J. L. Bates and R. R. Schemmel Jun. 1972 56 p refs
(Contract AT(45-1)-1830)
(BNWL-1671) Avail: NTIS

The electrical conductivity of ThO2 was measured from near room temperature to 2500 C. Measurements were also made to 800 C in a high intensity gamma radiation field. Experimental difficulties relating to high temperature measurements and measurements in gamma field are discussed in detail. Reported electrical conductivity data for ThO2 is reviewed. It is concluded that the wide variations in reported electrical conductivity data result principally from variations in oxygen pressures, sample compositions, and experimental techniques. At high temperatures, experimental measurements are complicated by the presence of large thermionic emission currents, gas conduction, and polarization. The reported increases in conductivity induced by gamma radiation are related to the ionization of the gas surrounding the sample instead of induced solid-state conduction. ThO2 is a mixed ionic-electronic conductor, depending upon the oxygen pressure and dopant composition. It is a p-type conductor at low temperatures and an apparent n-type conductor above 1400 C. NSA

N73-21476# Rutherford High Energy Lab., Chilton (England).
EPOXY RESINS FOR SUPERCONDUCTING MAGNET ENCAPSULATION
D. Evans, J. T. Morgan, and G. B. Stapleton Sep. 1972 27 p refs
(RHEL/R-251) Avail: AEC Depository Libraries; HMSO 35P; PHI $1.55

Experimental work on the evaluation of epoxy resin systems for use at liquid helium temperatures is reported. The various criteria are discussed and the tests used to evaluate the potential worth of a large number of systems are described. Tabulations are given of the performance of selected resin systems. Author (NSA)

N73-21477# Royal Aircraft Establishment, Farnborough (England).

THE STRENGTH AND STIFFNESS IN TRANSVERSE TENSION OF UNIDIRECTIONAL CARBON FIBRE REINFORCED PLASTIC

D. L. Mead Aug. 1972 31 p refs

(RAE-TR-72129) Avail: NTIS HC $3.75

The development of test specimens for the determination of the tensile strength, strain to failure, and Young's modulus of unidirectional carbon fiber reinforced plastics in a direction perpendicular to the fibers is described. Also presented are the results of a series of transverse tensile measurements in which the variations with fiber volume fraction of these properties were determined. Fiber type and composite manufacturing technique were also varied to detect any associated viriation in composite properties. ESRO

N73-21478# Defense Documentation Center, Alexandria, Va.

CERAMIC MATERIALS Report Bibliography, Aug. 1954 - Jun. 1972

Feb. 1973 359 p refs

(AD-755650; DDC-TAS-72-83) Avail: NTIS CSCL 11/2

The bibliography contains unclassified and unlimited reports on ceramic materials. The following subtopics are covered: Processing and manufacturing of ceramic materials; Ceramic coatings; Physical properties of ceramic materials; High temperature applications of ceramic materials; and The use of ceramic materials in electronic devices. Indexes to Corporate Author-Monitoring Agency, Subject, Personal Author, and AD-Number are included. Author (GRA)

N73-21479# Army Foreign Science and Technology Center, Charlottesville, Va.

SELECTIVE FILMS ON GLASS AND THEIR CHARACTERISTICS

N. B. Rekant and A. V. Sheklein 31 Oct. 1972 14 p refs Transl. into ENGLISH of the publ. "Preobrazovateli Solnechnoi Energii na Poluprovodnikakh" Moscow, Nauka, 1968

(AD-755250; FSTC-HT-23-1028-72) Avail: NTIS CSCL 11/3

The work presents a study of the most interesting optical properties of films based on tin dioxide and the oxides of cobalt from the standpoint of solar engineering. Author (GRA)

N73-21480# Artech Corp., Falls Church, Va.

EVALUATION OF MULTILAYER THIN FLIMS, PHASE 1 Final Report, 15 May - 31 Aug. 1972

Fred Ordway Dec. 1972 38 p refs

(Contract DAAK02-72-D-0223)

(AD-755924; J7114.03-FR) Avail: NTIS CSCL 11/4

Thin films of metals were described by a number of investigators to have extremely high mechanical strength. The program is aimed at determining the potential usefulness of composites made up of alternating thin films of a metallic substance and an amorphous nonmetal. In this phase of the work, methods of specimen preparation, measurement, and bulge testing to determine mechanical properties were established for thin metallic films and measurements were made of films of aluminum 200-870A thick and of titanium 200-750A thick. Estimated ultimate strengths of the aluminum films ranged from 50 to 92 kpsi and those of the titanium films from 93 to 150 kpsi, the highest value representing the thinnest film.

Author (GRA)

N73-21481# Connecticut Univ., Storrs. Dept. of Metallurgy.

ON AXIAL EXTENSION DURING CYCLIC TORSION

W. G. Ovens, A. V. Anandaswaroop, and A. J. McEvily Dec. 1972 19 p refs

(Contract F44620-69-C-0011; AF Proj. 9560)

(AD-755891; UC-Met-11-72; AFOSR-73-0271TR) Avail: NTIS CSCL 11/4

An axial extension that takes place during cyclic torsion over a large number of cycles is known as the Ronay effect. In a directionally solidified eutectic of solid cross section, the tendency for the surface layers to elongate during cyclic tension is resisted by the interior with the result that elastic buckling of the fibers in the surface layers occurs. An explanation for this type of effect is advanced which is based upon the elastic distortion of the lattice and the anisotropy of the slip process in the matrix. Author (GRA)

N73-21482# North Carolina State Univ., Raleigh.

AN EXPERIMENTAL INVESTIGATION OF THE BEHAVIOR OF POLYCARBONATE (LEXAN) SUBJECTED TO IMPACT LOADING: LARGE AMPLITUDE ELASTIC WAVE PROPAGATION AND DYNAMIC MATERIAL PROPERTIES

W. L. Liddell, Y. Horie, and R. A. Douglas Dec. 1972 97 p refs

(Contract N00014-68-A-0187; NR Proj. 064-504)

(AD-755457; TR-72-2) Avail: NTIS CSCL 11/9

Strain-time and surface rotation-time data are reported for twenty-seven tests involving axial impact of 0.741 inch diameter polycarbonate (Lexan) rods. An analysis is made of the data to determine various dynamic properties of Lexan, such as: Strain wave speeds in Lexan rod as a function of strain level and position along the rod; The dilatational wave speed for small strain; Strain wave speeds under approximate one-dimensional stress conditions; Young's modulus and Poisson's ratio for small strain; A dynamic stress-strain curve; The variation of Poisson's ratio with strain under dynamic conditions; The elastic-plastic transition strain under short-time (approximately 120 microseconds) loading-unloading conditions; The effect of multiple impacts on the strain-time history; The feasibility of predicting elastic strain-time histories in Lexan rod using wave superposition and measured wave speed data. Author (GRA)

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see specific categories. For related information see also: 08 Computers.

N73-21483*# Translation Consultants, Ltd., Arlington, Va.

NUMERICAL METHODS IN THE THEORY OF RAREFIED GASES

V. P. Shidlovskiy, ed. Washington NASA Jul. 1971 194 p refs Transl. into ENGLISH of the book "Chislennyye Metody v Teorii Razrezhennykh Gazov" Moscow, USSR Acad. of Sci., 1969

(Contract NASw-2038)

(NASA-TT-F-638; F-638) Avail: NTIS HC $3.00 CSCL 12A

Studies aimed at developing methods for solving the mechanics problems involved in rarefied gases are reported. Most of the investigations deal with attempts to find accurate solutions of the Boltzmann equation. In addition, the problem of interaction of gas particles with the surface of solids is considered, and the classical Enskog-Chapman method is applied to the flow of chemically active gas mixtures. For individual titles, see N73-21484 through N73-21493.

N73-21484* Translation Consultants, Ltd., Arlington, Va.

NUMERICAL METHODS FOR SOLVING THE BOLTZMANN EQUATION (A REVIEW)

Ye. F. Limar, Ye. M. Shakhov, and V. P. Shidlovskiy *In its* Numerical Methods in the Theory of Rarefied Gases Jul. 1972 p 1-18 refs (For availability see N73-21483 12-19)

CSCL 12A

The methods are reviewed which are utilized in principal attempts to obtain the numerical solution or modeling of the Boltzmann equation over a broad range of Knudsen numbers. The primary methods considered are the Monte Carlo and the discrete velocities methods. The conculsions drawn from the analysis include the following: (1) The Monte Carlo methods are not well suited in the area of small Knudsen numbers. (2) Among the Monte Carlo methods, the Bird method appears to be the most attractive, since it is more directly related to the Boltzmann equation. (3) The deterministic methods, which include the discrete ordinate technique, offer great possibilities but require exceedingly large computer times. (4) The use of approximating equations in combination with the discrete velocities method will possibly improve computation time and reduce the required memory volume. D.L.G.

N73-21485* Translation Consultants, Ltd., Arlington, Va.

SOME SPATIALLY HOMOGENEOUS GAS MOTIONS

V. A. Rykov and F. G. Cheremisin *In its* Numerical Methods in the Theory of Rarefied Gases Jul. 1972 p 19-33 refs (For

availability see N73-21483 12-19)
CSCL 12A

A functional equation is derived for a spatially homogeneous distribution function and examples of spatially homogeneous gas motions are considered. Numerical calculation was conducted for one such motion with the use of a model equation. Author

N73-21486* Translation Consultants, Ltd., Arlington, Va.
SOLUTION OF THE BOLTZMANN KINETIC EQUATION FOR THE RELAXATION OF A GAS MIXTURE
V. A. Rykov and T. I. Chukanova *In its* Numerical Methods in the Theory of Rarefied Gases Jul. 1972 p 34-42 refs (For availability see N73-21483 12-19)
CSCL 12A

The temporal behavior is considered of a quiescent mixture of gases of different temperatures with spatially uniform distribution. The process of heating a cold gas by a hot gas is treated on the basis of the Boltzmann kinetic equation. The mixture is assumed to be composed of absolutely hard smooth spheres, and the initial distribution functions for each gas is taken to the Maxwellian. With such a choice of initial distribution functions, it is shown that the solution of the Boltzmann kinetic equation depends only on the velocity modulus and the time. D.L.G.

N73-21487* Translation Consultants, Ltd., Arlington, Va.
A METHOD FOR DIRECT NUMERICAL INTEGRATION OF THE BOLTZMANN EQUATION
F. G. Cheremisin *In its* Numerical Methods in the Theory of Rarefied Gases Jul. 1972 p 43-63 refs (For availability see N73-21483 12-19)
CSCL 12A

The principal difficulties in numerical solution of the Boltzmann equation are considered. The study is aimed at formulating a numerical solution in such a manner that it contains a minimum amount of excess information at the distribution function level. It is pointed out that the accurate calculation of the distribution function at each point in phase space requires a tremendous number of operations, due to the necessity of solving five-fold quadratures in the collision integral. This results in the operational memory of the digital computer being insufficient to store all the data on the distribution functions at the necessary points in phase space. An algorithm is constructed involving successive iterations of the Boltzmann equation which does not require storage of each step of the new distribution function. D.L.G.

N73-21488* Translation Consultants, Ltd., Arlington, Va.
THE STRUCTURE OF SHOCK WAVE IN A GAS CONSISTING OF IDEALLY ELASTIC, RIGID SPHERICAL MOLECULES
c12
F. G. Cheremisin *In its* Numerical Methods in the Theory of Rarefied Gases Jul. 1972 p 64-78 refs (For availability see N73-21483 12-19)
CSCL 20D

Principal approaches are examined to the theoretical study of the shock layer structure. The choice of a molecular model is discussed and three procedures are formulated. These include a numerical calculation method, solution of the kinetic relaxation equation, and solution of the Boltzmann equation. D.L.G.

N73-21489* Translation Consultants, Ltd., Arlington, Va.
THE SOLUTION OF THE RELAXATION PROBLEM FOR THE BOLTZMANN EQUATION BY THE INTEGRAL ITERATION METHOD
Ye. F. Limar *In its* Numerical Methods in the Theory of Rarefied Gases Jul. 1972 p 79-84 refs (For availability see N73-21483 12-19)
CSCL 12A

The Boltzmann equation is considered in terms of the problem of relaxation of some initial distribution function which depends only on velocities, to Maxwell's distribution function. The Boltzmann equation is given for the relaxation problem in which the distribution function f(t, u, v) is time dependent and is also dependent on two other variables u and v (the velocities of rigid spherical molecules). An iteration process is discussed in which the velocity space u, v is subdivided into squares, the distribution function in each square being approximated by the second-order surface from the values of the distribution function at nine points. The set of all of these points forms a network of u, v values at the nodes of which the distribution function can be found. D.L.G.

N73-21490* Translation Consultants, Ltd., Arlington, Va.
APPROXIMATION METHOD FOR THE KINETIC BOLTZMANN EQUATION
Ye. M. Shakhov *In its* Numerical Methods in the Theory of Rarefied Gases Jul. 1972 p 85-123 refs (For availability see N73-21483 12-19)
CSCL 12A

The further development of a method for approximating the Boltzmann equation is considered and a case of pseudo-Maxwellian molecules is treated in detail. A method of approximating the collision frequency is discussed along with a method for approximating the moments of the Boltzmann collision integral. Since the return collisions integral and the collision frequency are expressed through the distribution function moments, use of the proposed methods make it possible to reduce the Boltzmann equation to a series of approximating equations. D.L.G.

N73-21491* Translation Consultants, Ltd., Arlington, Va.
MODELS FOR THE INTERACTION OF RAREFIED GAS WITH A SURFACE
A. A. Pyarnpuu *In its* Numerical Methods in the Theory of Rarefied Gases Jul. 1972 p 124-146 refs (For availability see N73-21483 12-19)
CSCL 12A

Various theoretical models are discussed for the interaction of gaseous atoms with solids at energies of approximately 10 eV. The surface is modeled by a one- and three-dimensional aggregate of atoms with different initial conditions and lattice parameters. In calculating the accommodation coefficients, the direct integration of the equations of motion of gaseous molecules and atoms in the crystal lattice of the solid is used. An analysis of the advantages and the drawbacks of the models, as well as the possibilities of the analytical solutions in a one-dimensional case, is given. The dependence of the energy and the normal and the tangential momenta accommodation coefficients on the collision parameters is obtained. Author

N73-21492* Translation Consultants, Ltd., Arlington, Va.
TRANSFER PHENOMENA IN REACTING GAS MIXTURES
c12
B. V. Alekseyev *In its* Numerical Methods in the Theory of Rarefied Gases Jul. 1972 p 147-179 refs (For availability see N73-21483 12-19)
CSCL 20D

In considering transfer phenomena in reacting gas mixtures, the following topics are discussed: (1) dynamics of paired collisions; (2) Enskog method for solving the Boltzmann equation, taking into account inelastic collisions; (3) use of the variation principle for approximate solutions; (4) computations of inelastic bracketed expressions; (5) calculation of collision integrals; and (6) formulas for transfer coefficients. D.L.G.

N73-21493* Translation Consultants, Ltd., Arlington, Va.
PERTURBATION OF THE MAXWELLIAN DISTRIBUTION IN CHEMICALLY REACTING GAS MIXTURES
B. V. Alekseyev and V. R. Yanovskiy *In its* Numerical Methods in the Theory of Rarefied Gases Jul. 1972 p 180-188 refs (For availability see N73-21483 12-19)
CSCL 12A

Chemically reacting gas mixtures are considered for the case in which inelastic collisions occur significantly less frequently than elastic ones. The first approximation of the general solution of the Boltzmann equation is developed and is shown to contain an additional scaler term. The concentration, the mean mass velocity, and the temperature of the mixture are determined and the rate of reaction in the first approximation is formulated. Tables are presented which give reaction rate values obtained by both the first and second approximation for different activation energies. The tables show that the first approximation is sufficient for practical purposes for calculating the reaction rate. D.L.G.

N73-21494# RAND Corp., Santa Monica, Calif.
ASYMPTOTIC PROPERTIES OF FULL INFORMATION ESTIMATORS IN DYNAMIC AUTOREGRESSIVE SIMUL-

TANEOUS EQUATIONS MODELS
Phoebus J. Dhrymes Nov. 1972 13 p refs
(P-4924) Avail: NTIS HC $3.00

Based on an examination of the problem of estimating in simultaneous equations models, by maximum likelihood, and the three stage least squares procedure, the joint asymptotic distribution of estimators is derived. F.O.S.

N73-21495# RAND Corp., Santa Monica, Calif.
A MODEL FOR THE ANALYSIS OF MARKOVIAN DECISION PROCESSES WITH UNOBSERVABLE STATES AND UNOBSERVABLE COSTS
James D. Steele Oct. 1972 9 p refs
(P-4917) Avail: NTIS HC $3.00

Based on a stationary policy for the Markovian decision process having finite state and section spaces, a model for finding a policy for taking actions which minimize the total expected discounted cost over the infinite future is developed. Cost functions are analyzed using this model. F.O.S.

N73-21496# RAND Corp., Santa Monica, Calif.
MARKOVIAN DECISION PROCESSES WITH LIMITED STATE OBSERVABILITY AND UNOBSERVABLE COSTS
James D. Steele Nov. 1972 15 p refs
(P-4925) Avail: NTIS HC $3.00

A finite-state finite-action Markovian decision process is considered for which the state space has been partitioned into subsets. The decisionmaker can only observe the subset to which the states of the process belong, and not the actual states of the process. In addition, the costs are unobservable in the sense that the total discounted cost is to be assessed at infinity. An approach to this problem, which makes use of the probability distributions over the state space, is developed. Author

N73-21497# Joint Publications Research Service, Arlington, Va.
MATHEMATICAL MODELS AND EDUCATIONAL PLANNING
M. A. Bermant, L. K. Semenkov, and V. N. Sulitskiy 19 Apr. 1973 100 p refs Transl. into ENGLISH of the book "Matematicheskiye Modeli i Planirovaniye Obrazovaniya" Moscow, Nauka Press, 1972 112 p
(JPRS-58793) Avail: NTIS HC $7.00

The application of mathematical methods to the planning and control of the personnel training process is discussed. A study was made of methods of assigning the requirements for specialists, and the methods of educational planning for the satisfaction of these requirements. An approach is proposed for the construction of the mathematical model of the planning and control of the process of meeting the need for specialists in any branch of the Soviet national economy. A survey of various foreign models of educational planning is also made. Author

N73-21498*# Scientific Translation Service, Santa Barbara, Calif.
OSCILLATION THEOREMS FOR DIFFERENTIAL EQUATIONS OF HIGHER ORDERS AND THE SPECTRUM OF THE CORRESPONDING DIFFERENTIAL OPERATORS
I. M. Glazman Washington NASA Apr. 1973 12 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 118, no. 3, 1958 p 423-426
(Contract NASw-2483)
(NASA-TT-F-14883) Avail: NTIS HC $3.00 CSCL 12A

Oscillatory solutions to ordinary differential equations are discussed and eight theorems are derived. Author

N73-21499*# Scripta Technica, Inc., Washington, D.C.
MATHEMATICAL AND COMPUTATIONAL PROBLEMS IN LINEAR DYNAMIC PROGRAMMING
Yu. P. Krivenkov NASA Mar. 1973 195 p refs Transl. into ENGLISH of the book "Matematicheskiye i Vychislitelnyye Voprosy Lineynogo Dinamicheskogo Programmirovaniya" Moscow, Computer Center of the Acad. of Sci. USSR, 1969
(Contract NASw-2036)
(NASA-TT-F-685) Avail: NTIS HC $3.00 CSCL 12A

A set of mathematical models, describing various modes of functioning of individual processes and their aggregates is derived, and several techniques for quantitative and qualitative analyses of such models are presented. These modeling techniques are applied to the analysis of Bellman's simple automobile production problem, modified by incorporation of a feedback flow of factors of production. Similar plans are derived for a warehouse and for demand on bank credit. Author

N73-21500# Lockheed Missiles and Space Co., Palo Alto, Calif.
ALGORITHM TO DETERMINE THE LOCATION OF A MOVING OBJECT
S. A. Filaretova [1973] 4 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Priborostr. (Leningrad), v. 16, no. 1, 1973 p 68-71
Avail: NTIS HC $3.00, National Translations Center, John Crerar Library, Chicago, Ill. 60616

An algorithm for determining the location of a moving object by inertial navigation methods is derived. It is shown that no numerical instability originates in realizing the algorithm for the specialized computer mounted on the vehicle. Author

N73-21501# California Univ., Los Angeles. Dept. of Systems Sciences.
AN EXAMPLE OF DECENTRALIZATION IN OBSERVING AND CONTROLLING A LINEAR STOCHASTIC SYSTEM
Riccardo Zoppoli Dec. 1972 16 p refs
(Grant AF-AFOSR-2319-72; AF Proj. 9769)
(AD-754984; AFOSR-73-0073TR) Avail: NTIS CSCL 12/1

Optimal control and measurement strategies are considered for stochastic linear dynamic systems with agents having non-identical information, such that one generates the measurement policy and the other control policy. It is shown that the derivation of the optimal measurement policy requires on-line optimization in this decentralized system. Author (GRA)

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N73-21502 National Lending Library for Science and Technology, Boston Spa (England).
RELATION BETWEEN TURBULENCE IN THE STRATOSPHERE GIVING RISE TO BUMPINESS AND THE VERTICAL DISTRIBUTIONS OF METEOROLOGICAL PARAMETERS
U. S. Buldovskij [1972] 13 p refs Transl. into ENGLISH from Tr. Gidrometeorol. Nauchn.-Issled. Tsentr. SSSR (Leningrad), v. 70, 1970 p 79-92
(NLL-M-22819-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The relationship is investigated between bumpiness-producing turbulence in the stratosphere and vertical distribution of meteorological parameters, with the aid of radiosonde data. A total of 65 laboratory flights were conducted, including 50 over the Caucasus and 15 over middle latitudes of the European U.S.S.R., at layers between 10 and 19 km for all flights. The results of the study of 270 instances of bumpiness from these flights revealed a direct relationship between bumpy conditions in the stratosphere and the vertical shear of the vector wind, in conjunction with the change in thermal stratification with altitude. J.M.M.

N73-21503 National Lending Library for Science and Technology, Boston Spa (England).
ON TEMPERATURE LAPSE RATES WITHIN THE LOWER 300 METER LAYER OF THE ATMOSPHERE
M. M. Borisenko [1972] 12 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 4, 1971 p 88-93
(NLL-M-22838-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

With the aid of the variance analysis method, an evaluation is made of the comparative influence of meteorological factors on the magnitude of the difference between the mean temperature lapse rate in the 2-289m layer and the lapse rates for the 2-49m 49-97m, 97-145m, 145-193m, 193-241m, and 241-289m sublayers. The dependence of these differences on the magnitude of the lapse rate in the 2-289m layer is shown to be operative only for the 2-49m and 145-289m layers. Author

N73-21504 Oklahoma Univ., Norman.
GRAVITY CURRENT MODEL APPLIED TO ANALYSIS OF SQUALL-LINE GUST FRONT Ph.D. Thesis
Jerome Paul Charba 1972 111 p
Avail: Univ. Microfilms Order No. 72-19018

The structure of a severe gust front which led the squall line of 31 May 1969 was examined from analysis of measurements from the National Severe Storm Laboratory (NSSL) network of surface stations located in central Oklahoma. Utilizing the analysis of the structure and the horizontal displacement of the cold outflow air mass, the mechanics of motion of the gust front were investigated. The gust front was found to be in approximate dynamic similarity to theoretical and experimental gravity currents. In this regard, it is speculated that high horizontal-momentum air in the thunderstorm downdraft, injected into the outflow current, has the tendency to increase the gust front's propagational speed and thus its internal Froude number from that which it would have if gravity were the only motive force. However, analytical evidence indicates this effect was small in the 31 May case.
Dissert. Abstr.

N73-21505 National Lending Library for Science and Technology, Boston Spa (England).
ON THE POSSIBILITY OF INCREASING THE ACCURACY OF RADAR MEASUREMENTS OF PRECIPITATION
K. S. Zhupahin [1972] 21 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), v. 239, 1969 p 93-100
(NLL-M-22841-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 2 NLL photocopy coupons

The improvement in accuracy of radar measurement of precipitation was investigated. Errors in signal measurement were studied relative to signal to noise ratios and the probability of a given signal to exceed threshold levels for detection. It is shown that maximum errors occur when a great difference exists between the structures of the measured and standard signals (e.g. one noisy and one determinate). Further, regarding signal conversion, it is concluded that the intensity of convection currents in clouds constitute the basic characteristics which determine optimum transformation operators in the signal conversion process.
J.M.M.

N73-21506 National Lending Library for Science and Technology, Boston Spa (England).
CHANGING WEATHER AND CLIMATE
E. K. Fedorov [1971] 19 p ref Transl. into ENGLISH from Priroda (Moscow), no. 9, 1971 p 36-44
(NLL-M-22821-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 2 NLL photocopy coupons

Man's relationship with the weather is investigated, along with his attempts to understand meteorological processes for the control of the climatological environment. The specific areas of possible meteorological control discussed include methods of modifying clouds and precipitation, the stimulation or suppression of rising air currents, and the modification of a wide variety of atmospheric physico-chemical processes. It is concluded that in order for a reliable means of weather transformation to be brought about, every link in the chain of meteorological processes must be completely understood in terms of its cause and effect.
J.M.M.

N73-21507 National Lending Library for Science and Technology, Boston Spa (England).
CALCULATION OF THE EXPECTED ANOMALY CRITERION FOR SOME METEOROLOGICAL FIELDS
D. I. Vachnadze and D. A. Ped [1972] 11 p refs Transl. into ENGLISH from Tr. Gidrometeorol. Nauchn.-Issled. Tsentr. SSSR (Leningrad), v. 76, 1971 p 27-37
(NLL-M-22804-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

Methods of forecasting the degree of anomaly of certain meteorological fields are reported. Data from the period 1949 to 1966 were used from observations over the Soviet Union and the Atlantic Ocean. Analysis of the time correlation function indicated that the degree of anomaly of meteorological fields was influenced by such factors as the initial anomaly, the degree of sinuosity of the frontal zone, the intensity of the zonal circulation of the atmosphere, and the temperature anomaly of the surface layer of water in the Atlantic Ocean.
J.M.M.

N73-21508*# California Univ., Los Angeles. Dept. of Meteorology.
DESIGN OF THE UCLA GENERAL CIRCULATION MODEL
Akio Arakawa 1 Jul. 1972 123 p refs
(Grants NGR-05-007-328)
(NASA-CR-131531; TR-7) Avail: NTIS HC $8.25 CSCL 04B

An edited version is reported of notes distributed at the Summer Workshop on the UCLA General Circulation Model in June 1971. It presents the computational schemes of the UCLA model, along with the mathematical and physical principles on which these schemes are based. Included are the finite difference schemes for the governing fluid-dynamical equations, designed to maintain the important integral constraints and dispersion characteristics of the motion. Also given are the principles of parameterization of cumulus convection by an ensemble of identical clouds. A model of the ground hydrology, involving the liquid, ice and snow states of water, is included. A short summary is given of the scheme for computing solar and infrared radiation transfers through clear and cloudy air.
Author

N73-21509*# GCA Corp., Bedford, Mass. Technology Div.
ATMOSPHERIC MOTION INVESTIGATION FOR VAPOR TRAILS AND RADIO METEORS Final Report
J. Bedinger Feb. 1973 28 p refs
(Contract NASw-2147)
(NASA-CR-131645; GCA-TR-73-2-N) Avail: NTIS HC $3.50 CSCL 04B

The dynamics are investigated of the lower thermosphere through comparison of optical observations of motions of ejected vapor trails with radar observations of motions of ionized meteor trails. In particular, the winds obtained from a series of vapor trail observations which occurred at Wallops Island, Virginia during the night of 14-15 December 1970 are to be compared with wind data deduced from radar observations of meteor trails during the same period. The comparison of these data is considered important for two reasons. First, the most widely used methods of measuring winds in the lower thermosphere are the vapor trails and the radar meteors. However, the two techniques differ markedly and the resultant sets of data have been analyzed and presented in different formats. Secondly, and possibly of greater immediate concern, is the fact that the radar meteor method appears to be an appropriate approach to the synoptic measurement of winds. During the night of 14-15 December 1970, five vapor trails were ejected from Nike Apache rockets over Wallops Island, Virginia from 2208 EST through 0627 EST. The wind data which were obtained from these trails are presented, and features of the wind profiles which relate to the radar meteor trails results are discussed.
Author

N73-21510# Joint Publications Research Service, Arlington, Va.
METEOROLOGY AND HYDROLOGY NO. 1, JANUARY 1973
V. A. Bugayev, ed. 15 Mar. 1973 105 p refs Transl. into ENGLISH from Meteorol. Gidrol. (Moscow), no. 1, Jan. 1973 p 3-123
(JPRS-58483) Avail: NTIS HC $7.25

U.S.S.R. research projects in meteorology and hydrology are discussed. The subjects presented are concerned with: (1) microclimate, (2) agricultural meteorology, (3) weather forecasting and climate control, (4) hydrological forecasting, and (5) atmospheric pollution. For individual titles, see N73-21511 through N73-21519.

N73-21511 Joint Publications Research Service, Arlington, Va.
URBAN CLIMATE AND THE PROBLEMS OF VARIATION OF THE GLOBAL CLIMATE
M. Ye. Berlyand, M. I. Budyko, and K. Ya. Kondratyev *In its* Meteorol. and Hydrol., No. 1, Jan. 1973 15 Mar. 1973 p 1-15 refs (For availability see N73-21510 12-20)

A study was made of the global effects of an increase in the carbon dioxide and aerosol content in the atmosphere. The effect of anthropogenic factors of the variation of the thermal conditions on the earth is estimated. The air pollution characteristics are presented, and the peculiarities of the temperature radiation distribution and wind velocities under urban conditions are analyzed. It is demonstrated that the urban climate can serve to a defined degree as a model of the human effect of the climate on a planetary scale.
Author

N73-21512 Joint Publications Research Service, Arlington, Va.
CONSERVATION OF LAKE BAYKAL c13
Yu. A. Izrael and A. A. Zenin *In its* Meteorol. and Hydrol., No. 1, Jan. 1973 15 Mar. 1973 p 16-22 (For availability see N73-21510 12-20)

The modern state of Lake Baykal, Russia, and the measures to protect the lake under the conditions of intense economic development of its basin are described. Data are presented on the effect of the purified discharges of the Baykal cellulose plant on the composition of the lake water. Some approaches to standardizing the discharge of polluted material into bodies of water are indicated. Author

N73-21513 Joint Publications Research Service, Arlington, Va.
DIMENSIONS OF RADIOACTIVE AEROSOLS AND THEIR TRANSPORT IN THE TROPOSPHERE AND STRATOSPHERE
I. L. Karol *In its* Meteorol. and Hydrol., No. 1, Jan. 1973 15 Mar. 1973 p 23-34 refs Presented at 10th Meeting of Interdepartmental Seminar on Radiant Heat Transfer in the Atmosphere, Leningrad, Nov. 1971 (For availability see N73-21510 12-20)

A brief survey is presented of the results of measuring the distribution of the radioactivity of different origin with respect to the aerosol dimensions in the troposphere and stratosphere and its variation with time. Information is presented on the global transfer and removal of radioactive aerosols from the atmosphere. Author

N73-21514 Joint Publications Research Service, Arlington, Va.
MACROSCALE INTERACTION OF THE ATMOSPHERE WITH THE OCEANS AND ROLE OF THE LATTER IN THE FORMATION OF ANOMALOUS CIRCULATION IN THE STRATOSPHERE
Kh. Kh. Rafailova *In its* Meteorol. and Hydrol., No. 1, Jan. 1973 15 Mar. 1973 p 35-46 refs (For availability see N73-21510 12-20)

The two-way interrelation of the ocean and atmosphere is demonstrated on the basis of data on the temperature of the surface layer of the water of the Atlantic and Pacific Oceans. The thermal conditions of the ocean water and air circulation in the stratosphere are discovered as functions of the direction of the prevailing flow in the equatorial stratosphere. Author

N73-21515 Joint Publications Research Service, Arlington, Va.
PROSPECTS FOR THE DEVELOPMENT OF AN AUTOMATED HYDROMETEOROLOGICAL SYSTEM
N. M. Potiyevskiy and V. D. Zhupanov *In its* Meteorol. and Hydrol., No. 1, Jan. 1973 15 Mar. 1973 p 47-55 (For availability see N73-21510 12-20)

A study was made of the problems of selecting the optimal area of automation of the hydrometeorological service connected with its technical reconstruction. The basic goals of the information-computation network are defined, the centers of which are equipped with standard software and hardware complexes including the Minsk-32 computer, the apparatus for coupling with the communications channels and specialized devices, representing and recording information. Author

N73-21516 Joint Publications Research Service, Arlington, Va.
PROCEDURE FOR CALCULATING OCEAN CURRENTS BY A GIVEN DENSITY FIELD c13
V. F. Kozlov *In its* Meteorol. and Hydrol., No. 1, Jan. 1973 15 Mar. 1973 p 56-63 refs (For availability see N73-21510 12-20)

The development of a procedure for calculating ocean currents by a given density field is discussed. Mathematical models involved in the application of the procedure are presented. The advantages of the system are described and the accuracy obtained is compared with other systems currently in use. Author

N73-21517 Joint Publications Research Service, Arlington, Va.
MAKING OPTIMAL ECONOMIC DECISIONS AS A METHOD OF IMPROVING THE EFFICIENCY OF AGROMETEOROLOGICAL FORECASTING
Ye. Ye. Zhukovskiy *In its* Meteorol. and Hydrol., No. 1, Jan. 1973 15 Mar. 1973 p 64-78 refs (For availability see N73-21510 12-20)

A general statement of the problem of improving the economic efficiency of agrometeorological forecasts by making statistically optimal economic decisions minimizing the mean losses to the consumer is presented. A study is made of the problem of making optimal decisions on taking preventive measures for frost control. The basic theoretical formulas are derived for calculating the optimal decision threshold and the economic efficiency of forecasting the minimal temperature. A specific numerical example is used to illustrate the possibility of practical utilization of the developed theory and expediency of converting to the optimal decision-making strategy regarding frost control measures. Author

N73-21518 Joint Publications Research Service, Arlington, Va.
SOME RESULTS OF EXPERIMENTS IN INCREASING THE STABILITY IN THE FLOW OF BPV TYPE CURRENT METERS c14
V. B. Titov *In its* Meteorol. and Hydrol., No. 1, Jan. 1973 15 Mar. 1973 p 79-87 refs (For availability see N73-21510 12-20)

A study was made of two methods of increasing the stability of BPV-2 and BPV-2r current pen recorders in a flow with respect to the effect of waves. Both procedures were checked experimentally under natural conditions. The experimental results indicate a decrease in the scattering of the measurement data for the current direction with an increase in the moment of inertia of the instruments. Author

N73-21519 Joint Publications Research Service, Arlington, Va.
INTRODUCTION TO THE SCIENTIFIC STUDY OF ATMOSPHERIC POLLUTION
M. Ye. Berlyand *In its* Meteorol. and Hydrol., No. 1, Jan. 1973 15 Mar. 1973 p 88-90 (For availability see N73-21510 12-20)

The preparation of study on the effects of air pollution is discussed. The subjects presented are: (1) basic characteristics of atmospheric pollution to show sources and discharges, (2) meteorological aspects of atmospheric pollution, (3) effects of atmospheric pollution on human physiology, (4) influences of air pollution on vegetation, and (5) organizing of a service to monitor air pollution. Author

N73-21520# RAND Corp., Santa Monica, Calif.
THE SENSITIVITY AND COMPARISON OF GENERAL ATMOSPHERIC CIRCULATION MODELS
Michael Warshaw Nov. 1972 14 p refs
(P-4933) Avail: NTIS HC $3.00

Computerized simulation of the global atmospheric circulation was studied to formulate statistical models, testing procedures, and data retrieval programs. Model sensitivity to changes in boundary conditions is discussed along with the agreement of models in predicting the same phenomena when the boundary conditions are identical. The comparisons of the models to the real atmosphere are also analyzed. J.M.M.

N73-21521# Dow Chemical Co., Freeport, Tex.
WARM FOG DISPERSAL TESTS WITH GLYCERINE IN THE PANAMA CANAL ZONE, PART 1 AND PART 2 Final Report, Sep. - Dec. 1972
J. McDuff, Z. Moore, L. Chumbley, T. Wright (Naval Weapons Center), and R. S. Clark (Naval Weapons Center) Jan. 1973 26 p refs
(Contracts DOT-FA72WA-2727; DOT-FA72WAI-316)
(TOPR-178-3-133-Pt-1; FAA-RD-73-21-Pt-1/Pt-2) Avail: NTIS HC $3.50

Field tests were conducted on warm fogs in the Panama Canal Zone using glycerine as the dispersal agent. The tests demonstrated that finely divided glycerine has the capability of dispersing warm fogs. Glycerine, heated to 65 C to reduce viscosity, was sprayed into the tops of fogs on six occasions. Post test analysis indicated that on one occasion conditions were less than desirable for valid fog dispersal evaluation. The fog on this occasion was wind driven, highly unstable, and in a constant state of flux. However, results from all six tests proved this technique effective in dispersing fog. Sharp troughs were repeatedly cut through fog layers as thick as 800 feet. Author

N73-21522# Rutgers Univ., New Brunswick, N.J. Center for Transportation Studies.
COMPARISON OF MOBILE SOURCE EMISSIONS FROM

AIRCRAFT, AUTOMOBILES, BUSES, TRUCKS, RAILROADS, AND ELECTRIC TRAINS (PROJECT EAGLE) Final Report, Mar. 1972 - Dec. 1972
Cooper Bright, Toivo Lamminen, Kenneth Hanko, James Mullaly, Robert Helfand, Richard Heller, Craig Pasco, Yvet Heving Hsu, Michael Tomasezwicz, Forest Markowitz et al Dec. 1972 448 p refs
(Contract DOT-FA72WA-2877)
(FAA-EQ-73-2) Avail: NTIS HC $24.50

Mobile source emissions from aircraft, automobiles, buses, trucks, railroads, and electric trains within the continental United States during the period 1940-1980 were compared. This included air pollution created by operations of air carriers and military and general aviation aircraft. The pollutants considered for all these modes of transportation were carbon monoxide, hydrocarbons and nitrogen oxides and, in addition, for electric trains, pollutant values for sulfur oxides and particulates. It was demonstrated that for the period 1940-1980 public carriers including air transportation showed significantly less air pollution than autos both in grams per passenger mile and total tons. For the same period, aircraft showed less air pollution than buses and railroads both in grams per passenger mile and total tons. This comparison of mobile source emissions pollution from aircraft, autos, buses, trucks, railroads and electric trains provides information required by planning agencies and legislative bodies in providing support for mass transit projects to assist in reducing air pollution and conserving dwindling petroleum resources. It was concluded that by developing aircraft suitable for operating intraurban mass air transportation in competition with automobiles would make possible drastic reduction in air pollution. Author

N73-21523*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
CLEAR AIR TURBULENCE DETECTOR Patent Application
Wener K. Dahm, Robert M. Huffaker, Albert V. Jelalian (Raytheon Co.), Irving Goldstein (Raytheon Co.), Wayne H. Keene (Raytheon Co.), Charles M. Sonnenschein (Raytheon Co.), Donald J. Delgrego, Sr. (Raytheon Co.), and Perry A. Miles, inventors (to NASA) (Raytheon Co.) Filed 11 Apr. 1973 30 p
(NASA-Case-MFS-21244-1; US-Patent-Appl-SN-350249) Avail: NTIS HC $3.50 CSCL 04B

Devices for the remote detection of atmospheric conditions and particularly for the detection and measurement of clear air turbulence are described. The velocity and range of turbulent aerosols are determined by means of a pulsed laser, Doppler radar system. A transmitter generates a train of short pulses of coherent light at a pulse repetition rate of 200 pulses per second. These pulses are amplified by a light amplifier and projected along the direction of search by transmit-receive optics. Reflected returns from aerosols are received by a detector which converts the received light pulses into radio frequency signals, typically having a Doppler content of 15 to 55 MHz. The output of the detector is fed through a matching network and a preamplifier to a mixer which also receives an input signal. The resulting data is displayed on a cathode ray display. NASA

N73-21524*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
TRIANGULATION ERROR ANALYSIS FOR THE BARIUM ION CLOUD EXPERIMENT M.S. Thesis - North Carolina State Univ.
Sheila Ann Thibeault Long 1973 156 p refs
(NASA-TM-X-69222) Avail: NTIS HC $10.00 CSCL 04A

The triangulation method developed specifically for the Barium Ion Cloud Project is discussed. Expression for the four displacement errors, the three slope errors, and the curvature error in the triangulation solution due to a probable error in the lines-of-sight from the observation stations to points on the cloud are derived. The triangulation method is then used to determine the effect of the following on these different errors in the solution: the number and location of the stations, the observation duration, east-west cloud drift, the number of input data points, and the addition of extra cameras to one of the stations. The pointing displacement errors, and the pointing slope errors are compared. The displacement errors in the solution due to a probable error in the position of a moving station plus the weighting factors for the data from the moving station are also determined. Author

N73-21525*# Kanner (Leo) Associates, Redwood City, Calif.
VISIBILITY RANGE IN THE PRESENCE OF VARIOUS METEOROLOGICAL PHENOMENA
Ye. N. Dovgyallo Washington NASA Apr. 1973 15 p refs Transl. into ENGLISH from Gl. Geofiz. Observ. imeni A. I. Voyeikova (USSR), no. 153, 1964 p 93-101
(Contract NASw-2481)
(NASA-TT-F-14886) Avail: NTIS HC $3.00 CSCL 04B

The application is made of a local statistical study of atmospheric transparency to the determination of the recurrence interval of various gradations in the meteorological visibility range in conditions of fog, haze, snowfall, snow storms, rain, and drizzle. It is found that the visibility is impaired most by fog, snow storms, and rainfall, in this order. Author

N73-21526# National Environmental Satellite Service, Washington, D.C.
STRATOSPHERIC PHOTOCHEMISTRY OF OZONE AND SST POLLUTION: AN INTRODUCTION AND SURVEY OF SELECTED DEVELOPMENTS SINCE 1965
Martin S. Longmire Mar. 1973 33 p refs
(NOAA-TM-NESS-47) Avail: NTIS HC $3.75

A review of current thinking on the stratospheric photochemistry of ozone is presented. The study is related to current plans for monitoring the stratosphere for climatic change and for determining other long-range effects arising from natural or human activities. Ozone and atomic oxygen are treated together as odd oxygen because they are converted into each other in the stratosphere through very rapid reactions. The reactions or chains of reactions considered most significant in determining stratospheric ozone are discussed in detail. It is contended that the reactions involving nitrogen oxides dominate those that destroy odd oxygen. The discussion is restricted to ozone photochemistry. A list of stratospheric constituents whose distributions should be monitored globally is also presented, together with a suggested order of priority of observation. Author

N73-21527# Hawaii Univ., Honolulu. Water Resources Research Center.
A RAINFALL CLIMATOLOGY OF HILO, HAWAII Partial Project Completion Report, 1 Jul. 1971 - 31 Dec. 1972
Charles M. Fullerton Dec. 1972 39 p refs Sponsored by Dept. of Interior.
(UHMET-72-03; TR-61) Avail: NTIS HC $4.00

Annual, monthly, and hourly rainfall data for Hilo, Hawaii are plotted and analyzed as a preliminary phase of the study of space-time variations in high intensity rainfall in this locality. A brief summary of the Hilo climate is provided. Annual rainfall amounts are shown to be highly variable, while the annual rainfall frequency remains relatively constant at about 33 percent. Monthly rainfall and maximum 24-hour rainfall amounts are displayed in the form of a monthly rainfall expectancy graph. Hourly rainfall amounts are divided into four intensity categories: 0.01 - 0.24, 0.24 - 0.49, 0.50 - 0.99 and equal to or greater than 1.00 inches per clock hour. The percentage distribution of annual and monthly rainfall amounts and frequencies by rainfall intensity category are plotted and discussed. Hourly data are displayed in a series of monthly diurnal distributions by rainfall intensity category. Author

N73-21528# Control Data Corp., Minneapolis, Minn. Meteorology Research Dept.
COMPARISON OF TROPICAL SYNOPTIC-SCALE WIND SPECTRA AND SEASONAL PARAMETERS Technical Progress Report
D. G. Dartt, D. N. Hovland, and A. D. Belmont 1 Mar. 1972 20 p refs
(Contract AT(11-1)-2153)
(COO-2153-1; TPR-1) Avail: NTIS

Regional synoptic wind component spectra for the Caribbean region are calculated and related to seasonal parameters. The Caribbean was chosen because of its mid-latitude and tropical wind variability. Author

N73-21529# Los Alamos Scientific Lab., N.Mex.
MONTE CARLO TRANSPORT ROUTINE FOR THE US STANDARD ATMOSPHERE (1962) TO AN ALTITUDE OF 90 KILOMETERS

C. J. Everett, E. D. Cashwell, and R. G. Schrandt Nov. 1972 8 p refs
(Contract W-7405-eng-36)
(LA-5089) Avail: NTIS

Following the 1962 U.S. Standard Atmosphere report (NASA, USAF, USWB), the earth's atmosphere to 90 km is subdivided into eight horizontal zones, in each of which the temperature is assumed a linear function of altitude. The barometric equation is integrated on this basis to obtain formulas for the numerical density function, which closely approximates the tabulation of the report cited. Further integration then yields Monte Carlo routines for the usual distance to collision decision. A flow diagram is included, with all required constants. The method, which is more realistic than an earlier one based on a single exponential density, may be used in conjunction with any neutron and/or photon code, but was intended primarily for the existing (MCP) photon code, which allows for pair production, coherent and incoherent scattering with appropriate form factors, and fluorescence subsequent to photo electric absorption. A series of such problems was run on the CDC-7600, with a monoenergetic photon point-source (.5, 1.5, 5.0 MeV) at 50 km altitude, directed vertically downward, using the U.S. Standard Atmosphere, and for comparison, an exponential atmosphere assumed in earlier studies. The direct transmission is tabulated, and some discussion of the results is included. In general, the U.S. Atmosphere allows less penetration with a factor of 1/2 or less not uncommon. Author

N73-21530# Institut Royal Meteorologique de Belgique, Brussels.
HYDROMETEOROLOGICAL STUDY OF PRECIPITATION OVER THE BELGIAN HYDROGRAPHIC BASINS. PART 4: THE LESSE BASIN [ETUDE HYDROMETEOROLOGIQUE DES PRECIPITATIONS SUR LES BASSINS HYDROGRAPHIQUES BELGES. 4 EME PARTIE: BASSIN DE LA LESSE]
Franz Bultot, Gerard L. Dupriez, and Nicole Bleiman 1972 66 p In FRENCH
(Publ-Ser-A-76) Avail: NTIS HC $5.50

The hydrometeorological study of precipitation over the Lesse Basin in Belgium is reported. It includes monthly, seasonal, annual, and diurnal variations of the water flow as well as the precipitation spatial distribution over the basin and the snow cover. ERSO

N73-21531# Naval Weapons Center, China Lake, Calif.
PROJECT FOGGY CLOUD 4. PHASE 2: WARM FOG MODIFICATION BY ELECTROSTATICALLY CHARGED PARTICLES
R. B. Loveland, J. G. Richer, M. H. Smith, and R. S. Clark Dec. 1972 45 p refs
(AD-754100; NWC-TP-5338; ECOM-5426) Avail: NTIS CSCL 04/2

Foggy Cloud IV, Phase II, is part of a continuing series of experiments concerning the modification and dispersal of warm fog. The primary purpose of Phase II was to evaluate the use of electrostatically charged particles as a means of improving visibility in warm fog. A charged-drop-producing system comprising an induction charging system and a water delivery system was developed for charging and delivering water drops. Tests were conducted at the Arcata-Eureka airport, McKinleyville, Calif., from 14 September to 5 November 1971, using a manned hot-air balloon as a research platform. Although a practical charging and delivery technique was developed, testing was inconclusive because of the lack of fog and the encountering of an unanticipated phenomenon, termed ground effect.
Author (GRA)

N73-21532# Weather Squadron (12th), Ent AFB, Colo.
THE APPLICATION OF COMPUTER MAP TYPING TO TERMINAL FORECASTING
Richard L. Nieman and Robert C. Sabin Oct. 1972 16 p refs
(AD-755898; Tech-Paper-72-3) Avail: NTIS CSCL 04/2

The 12th Weather Squadron has been conducting applied research into the field of computer-derived weather map types. The aim has been to incorporate map typing techniques into a terminal forecast system. Through the use of a electronic data processing methods, a technique has been developed to objectively select recurring circulation patterns. These patterns, or map types, can be developed into a catalog for a specific geographical area, depicting synoptic climatological information for each type. In real-time use, a centralized computer can provide the meteorologist with the map type for the current and prognostic synoptic situation and the associated climatological probabilities of different weather phenomena for each terminal. The meteorologist is thus provided with a reliable first-guess forecast. Author (GRA)

N73-21533# Air Weather Service, Scott AFB, Ill.
AIR WEATHER SERVICE WEATHER-MODIFICATION PROGRAM, FY 1972 Annual Report
Herbert S. Appleman, Ted S. Cress, Robert I. Sax, and Klaus M. Weickmann Dec. 1972 20 p refs
(AD-755659; AWS-TR-249; AR-5) Avail: NTIS CSCL 04/2

The annual report of the weather-modification activities of the Air Weather Service covers the projects, their operation and results, undertaken during FY 1972. Its primary purpose is to inform AWS field personnel of the progress in weather modification made during the year. Details of the projects are only briefly discussed as such details are published elsewhere, if warranted. Cold flake, cold wand, cold clear, cool view, and the Elmendorf ground-based propane system are the activities covered by this report. Author (GRA)

N73-21534# Chicago Univ., Ill. Lab. for Atmospheric Probing.
EFFECT OF FINITE RADAR PULSE VOLUME ON TURBULENCE MEASUREMENTS Technical Report, Aug. 1971 - Jul. 1972
Ramesh C. Srivastava and David Atlas 15 Jul. 1972 37 p refs Prepared in cooperation with Ill. Inst. of Tech., Chicago
(Contract N00014-67-A-0285-0014; Grant NSF GA-2768; NR-Proj. 061-188)
(AD-755440; TR-27) Avail: NTIS CSCL 04/1

Equations relating the mean of the Doppler spectrum and the distribution of point velocities, and their spectra are derived under the assumptions that: (1) the scatterers follow the air motion faithfully, (2) the reflectivity is constant, and (3) the beam illumination function is separable. Relationships between the 1-D longitudinal and transverse spectra of the mean velocity and the 3-D spectrum of the point velocities are derived. Numerical computations with a model Kolmogorov-Obukhov turbulence spectrum are performed to illustrate the effects of filtering. The ratio of the total energy under measured spectrum to that under spectrum of point velocities is computed as a function of beam dimensions. An equivalent rectangular filter approximation is proposed for computing the 1-D spectra. Analytical results are obtained for longitudinal spectrum and are shown to be in excellent agreement with numerical results for actual filter. GRA

N73-21535# Chicago Univ., Ill. Lab. for Atmospheric Probing.
DOPPLER TURBULENCE MEASUREMENTS IN AN EVAPORATING STALACTITE CLOUD BASE ZONE
D. Atlas, R. S. Sekhon, and R. J. Serafin 1 Jul. 1972 26 p refs Prepared in cooperation with Ill. Inst. of Tech., Chicago
(Contract N00014-67-A-0285-0014; Grant NSF GA-27680X; NR Proj. 061-188)
(AD-755441; TR-30) Avail: NTIS CSCL 04/2

The evaporating base of an ice crystal cloud deck is commonly marked by mammata-form vertical appendages which have come to be called stalactites. Because this zone is cooled by evaporation from above, its lower portion becomes convectively unstable and turbulence may result (Atlas, 1955). The primary objective of this work is to measure and describe the vertical air motions in a case of moderate turbulence associated with a stalactite zone. A secondary goal is to assess the validity of the use of the root mean square (rms) Doppler velocity in lieu of the mean Doppler velocity in turbulence (and other) measurements. This problem is of interest because the former is simpler to measure than the latter and is in more widespread use. GRA

N73-21536# Chicago Univ., Ill. Lab. for Atmospheric Probing.
RADAR MEASUREMENT OF THE ATMOSPHERIC TURBULENCE STRUCTURE FUNCTION Technical Report, 1 Jun. 1971 - 1 May 1972
Robert J. Serafin Jun. 1972 96 p refs Prepared in cooperation with Ill. Inst. of Tech.
(Contract N00014-67-A-0285-0014; Grant NSF GA-27680X; NR Proj. 061-188)
(AD-755439; TR-26) Avail: NTIS CSCL 04/1

Two methods for measuring the structure function are considered. The first employs conventional pluse Doppler signal processing while the second is intended for use with incoherent radars. Theoretical expressions are given for computing the mean square error of each method as a function of the measurement time and the Doppler spectral shape. An experimental laboratory simulation using the first model of the incoherent detector is described. The simulation results, analyzed with a digital computer, are shown to be in agreement with theory.
Author (GRA)

N73-21537# Calspan Corp., Buffalo, N.Y.
AN AREA CURVE FITTING METHOD FOR ANALYSIS OF DOPPLER WEATHER RADAR WITH APPLICATIONS TO THE STUDY OF CONVECTIVE STORMS Final Report, 1 Dec. 1971 - 31 Jan. 1973
Calvin C. Easterbrook and C. William Rogers Jan. 1973 69 p refs
(Contract N00014-72-C-0176)
(AD-755946; CK-5077-M-1) Avail: NTIS CSCL 04/2

A two-dimensional curve fitting technique is developed for analyzing data acquired by a single Doppler radar. The method provides measurements of the divergence and deformation fields and the combined effects of wind velocity and vorticity. The analysis method is tested on both artificial and real Doppler data. These tests indicate that the method can provide measurements of the differential kinematic properties of the wind field to a accuracy of better than plus or minus 0.5 x 10 to the minus 3rd power/sec and probably approaching plus or minus 0.25 x 10 to the minus 3rd power. Author

N73-21538# George Washington Univ., Washington, D.C. Program in Logistics.
AVERAGING TIME AND MAXIMA FOR DEPENDENT OBSERVATIONS
Nozer D. Singpurwalla (Calif. Univ., Berkeley) and Richard E. Barlow 20 Dec. 1972 35 p refs Submitted for publication
(Contract N00014-67-A-0214-0001; N00014-69-A-0200-1036; Grants NSF GU-3287; NSF GP-29123; NSF GK-23153; NR Proj. 347-020)
(AD-754433; Serial-T-273) Avail: NTIS CSCL 13/2

For the purposes of evaluating air quality, it is important to know the probability that maximum pollutant concentrations will exceed state standards stated for various averaging times. Extreme value theory can be used if it is reasonable to assume that observations on air pollutant concentrations are independent. Since it is well known that air pollution data is highly correlated, it is reasonable to look upon this data as a time series in which the successive observations are correlated. In the report, the authors present a new approach for analyzing certain time series processes. They show that, under certain conditions, several stochastic processes which could generate a time series for air pollutant data are associated. The processes considered are the autoregressive, the Markov and a stationary Gaussian process with a specified autocorrelation function. It is shown that the extreme value distribution provides a lower bound on the distribution function of the maxima of averages of observations generated by an associated stochastic process. Author (GRA)

N73-21539# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
THE 11602 LANCE, MISSILE NO. 2174, ROUND NO. 181 SST (9 JANUARY 1973) Meteorological Data Report
Jan. 1973 51 p
(DA Proj. 1T6-65702-D-127)
(AD-755773; DR-754) Avail: NTIS CSCL 04/2

Meteorological data gathered for the launching of 11602 Lance, Missile Number 2174, Round Number 181 SST, are presented in tabular form. Author (GRA)

N73-21540# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
THE 12803 LANCE, MISSLE NO. 2354, ROUND NO. 182 EST (16 JANUARY 1973) Meteorological Data Report
Jan. 1973 21 p
(DA Proj. 1T6-65702-D-127)
(AD-755774; DR-755) Avail: NTIS CSCL 04/2

Meteorological data gathered for the launching of 12803 Lance, Missile Number 2354, Round Number 182 EST, are presented in tabular form. Author (GRA)

N73-21541# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
THE 14101 RIP, MISSILE NOS. 12723/12720, ROUND NOS. 3/4 (17 JANUARY 1973) Meteorological Data Report
Jan. 1973 28 p
(DA Proj. 1T6-65702-D-127)
(AD-755775; DR-756) Avail: NTIS CSCL 04/2

Meteorological data gathered for the launching of 14101 RIP, Missile Numbers 12723/12720, Round Numbers 3/4, are presented in tabular form. Author (GRA)

N73-21542# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
ATHENA H-005, FLIGHT 137 (12 JANUARY 1973) Meteorological Data Report
John M. Sharpe Jan. 1973 53 p refs
(DA Proj. 1T6-65702-D-127)
(AD-755776; DR-757) Avail: NTIS CSCL 04/2

Meteorological data gathered for the launching of Athena Flight 137, Vehicle H-005, are presented for the Air Force Space and Missile Systems Organization and for ballistic studied. The data are presented in tabular and figure form. Author (GRA)

N73-21543# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
THE 13401 HONEST JOHN, MISSILE NO. 2598, ROUND NO. 628 RML (18 JANUARY 1973) Meteorological Data Report
Jan. 1973 23 p
(DA Proj. 1T6-65702-D-127)
(AD-755777; DR-758) Avail: NTIS CSCL 04/2

Meteorological data gathered for the launching of 13401 Honest John, Missile Number 2598, Round Number 628 RML, are presented in tabular form. Author (GRA)

N73-21544# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
THE 12805 LANCE, MISSILE NO. 2170, ROUND NO. 176 SST (13 DECEMBER 1972) Meteorological Data Report
Dec. 1972 53 p
(DA Proj. 1T6-65702-D-127)
(AD-755768; DR-749) Avail: NTIS CSCL 04/2

Meteorological data gathered for the launching of 12805 Lance, Missile Number 2170, Round Number 176 SST, are presented in tabular form. Author (GRA)

N73-21545# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
THE 11602 LANCE, MISSILE NO. 2352, ROUND NO. 177 EST (18 DECEMBER 1972) Meteorological Data Report
Dec. 1972 52 p
(DA Proj. 1T6-65702-D-127)
(AD-755769; DR-750) Avail: NTIS CSCL 04/2

Meteorological data gathered for the launching of 11602 Lance, Missile Number 2352, Round Number 177 EST, are presented in tabular form. Author (GRA)

N73-21546# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
THE 12804 LANCE, MISSILE NO. 2148, ROUND NO. 178 SST (21 DECEMBER 1972) Meteorological Data Report
Dec. 1972 53 p
(DA Proj. 1T6-65702-D-127)
(AD-755770; DR-751) Avail: NTIS CSCL 04/2

Meteorological data gathered for the launching of 12804 Lance, Missile Number 2148, Round Number 178 SST, are presented in tabular form. Author (GRA)

N73-21547# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
ATHENA H-009, FLIGHT 136 (12 JANUARY 1973) Meteorological Data Report
Jan. 1973 53 p
(DA Proj. 1T6-65702-D-127)
(AD-755779; DR-762) Avail: NTIS CSCL 04/2

Meteorological data gathered for the launching of Athena Flight 136, Vehicle H-009, are presented for the Air Force Space and Missile Systems Organization and for ballistic studies. The data are presented in tabular and figure form. Author (GRA)

N73-21548# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
THE 11602 LANCE, MISSILE NO. 2176, ROUND NO. 183 EST (19 JANUARY 1973) Meteorological Data Report
Jan. 1973 41 p
(DA Proj. 1T6-65702-D-127)
(AD-755778; DR-759) Avail: NTIS CSCL 04/2

Meteorological data gathered for the launching of 11602 Lance, Missile Number 2176, Round Number 183 EST, are presented in tabular form. Author (GRA)

N73-21549# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
THE 12803 LANCE, MISSILE NO. 2351, ROUND NO. 179 EST (22 DECEMBER 1972) Meteorological Data Report
Dec. 1972 33 p
(DA Proj. 1T6-65702-D-127)
(AD-755771; DR-752) Avail: NTIS CSCL 04/2

Meteorological data gathered for the launching of 12803 Lance, Missile Number 2351, Round Number 179 EST, are presented in tabular form. Author (GRA)

N73-21550# Bowles Fluidics Corp., Silver Spring, Md.
DEVELOPMENT OF METEOROLOGICAL TWO-AXIS WIND SENSOR Final Report, 3 Jan. 1972 - 2 Jan. 1973
Vincent F. Neradka Feb. 1973 40 p refs
(Contract N00014-72-C-0203; NR Proj. 211-150)
(AD-755740; BFC-R-02-16-73) Avail: NTIS CSCL 04/2

A two-axis fluidic wind sensor has undergone further development toward the goal of providing a no-moving-part, self-contained wind measuring system. A pair of fluidic wind sensors provide the inputs to an electronics package which accepts the pressure signals and computes magnitude and direction from the fluidic signals. Because of the importance of having a matched pair of sensors for accuracy of computation, nozzle fabrication techniques which have been pursued are discussed. A single axis version of the two-axis system was field tested, and the unit was found to be unaffected after a 15-week exposure in the Macon, Georgia area. Author (GRA)

N73-21551# Aerometric Research, Inc., Goleta, Calif.
DOWNWIND METEOROLOGICAL EFFECT OF CLOUD SEEDING
Robert D. Elliott China Lake, Calif. Naval Weapons Center Sep. 1972 21 p refs
(Contract N66001-70-C-0057)
(AD-755724; NWC-TP-5033) Avail: NTIS CSCL 04/2

A time-dependent two-dimensional numerical model was employed to test the hypothesis that a dynamically produced meteorological jump is responsible for increases in precipitation well downwind from the primary seeding area. This hypothesis predicts that such a jump will occur in the predominantly dry airstream moving above the layer of storm cloudiness, and will lie some 65 to 115 kilometers downwind of the seeding-produced equivalent heat mountain. Inputs to the numerical model were typical storm soundings abstracted from a large number of storm observations covering the range of conditions expected in the western part of the United States. An equivalent heat mountain was allowed to grow to a certain maximum size at the lower boundary of the upper airstream over a period of time commensurate with that required to produce primary seeding effects. Author (GRA)

N73-21552# General Dynamics/Electronics, San Diego, Calif.
NORPAX TECHNICAL REPORT: A PRELIMINARY ANALYSIS OF OCEANOGRAPHIC/METEOROLOGICAL SENSORS FOR OCEAN DATA STATIONS Technical Report, Sep. 1972 - Jan. 1973
D. L. Berquist, J. H. Hinchman, K. Samples, R. P. Lohrbach, and C. K. Rutledge Feb. 1973 89 p
(Contract N00014-70-C-0180; NR Proj. 083-147)
(AD-755755; R-73-006) Avail: NTIS CSCL 04/2

A study examining existing ocean data buoy instrumentation performance characteristics to determine realistic measurement accuracy was performed. Standard meteorological and oceanographic parameters as measured by instruments located aboard a discus shaped buoy were examined. Significant factors affecting measurement accuracy are identified and mathematically combined to determine a realistic error value (performance estimate). Range, natural variability, measurement averaging/filtering, data sampling rate, measurement resolution, and sensor/buoy interactions are considered for each parameter. The performance estimate for each parameter reflects the selected instrument operating characteristics on an ocean data station (buoy) in a marine environment. Author (GRA)

N73-21356* California Univ., Davis. Dept. of Agricultural Engineering.
INVESTIGATION OF ATMOSPHERIC EFFECTS IN IMAGE TRANSFER
K. L. Coulson and R. L. Walraven *In its* An Integrated Study of Earth Resources in the State of Calif. Using Remote Sensing Tech. 1 Feb. 1971 11 p Original contains color illustrations
(For availability see N73-21347 12-13)
CSCL 04B

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N73-21553 Mississippi Univ., University.
THEORETICAL AND EXPERIMENTAL EVALUATION OF A SINGLE CHANNEL PHASE COMPARISON SCHEME Ph.D. Thesis
V. V. Varadarajan 1972 134 p
Avail: Univ. Microfilms Order No. 72-20241

A single channel phase comparison scheme for direction finding purposes is analyzed in light of modern statistical communication theory, and it is shown that the system sensitivity can be predicted quite accurately in comparison with measured results obtained on an experimental model of the composite receiving system. The phase comparison scheme employs dual-mixing and standard heterodyning techniques to derive a low frequency signal containing the required phase information. The main feature of the scheme is the use of a single common channel after the initial mixing stage to process both the signals between which a phase comparison is desired. Single channel operation is obtained by offsetting the frequency of one of the signals to be compared in phase, so that both signals can be transmitted simultaneously in the same network. Dissert. Abstr.

N73-21554# Electromagnetic Compatibility Analysis Center, Annapolis, Md.
IN-BAND COMPATIBILITY ANALYSIS OF THE RTCA-PROPOSED MICROWAVE LANDING GUIDANCE SYSTEM (LGS) AND CANDIDATE SYSTEMS
Robert A. Frazier Jul. 1972 232 p refs Prepared in cooperation with IIT Res. Inst., Annapolis
(Contracts DOT-FA70WAI-175; F19628-71-C-0221; AF Proj. 649E)
(ECAC-PR-72-069; FAA-RD-72-62) Avail: NTIS HC $13.75

The electromagnetic compatibility among the proposed next generation microwave landing guidance system (LGS) and several existing microwave landing guidance systems proposed as interim candidates was analyzed. The angle data localizer and glideslope portions of the systems were deployed in an FAA-predicted high density 1980 environment and the possibility of compatible operation was assessed with the assistance of a computer analysis. The compatibility among the systems DME functions was analyzed using frequency/distance considerations. The EMC between the landing guidance systems and other in-band domestic systems and between the LGS and a foreign microwave enroute guidance satellite system (DIOSCURES) were analyzed using frequency/distance considerations. Author

N73-21555# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON THE REORIENTATION OF A SPACE VEHICLE

S. M. Lobanov [1972] 6 p refs Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. 1: Mati i Mekhan. (Moscow), no. 5, 1972 p 88-94
Avail: NTIS HC $3.00; National Translation Center, John Crerar Library, Chicago, Ill. 60616

A stabilized space vehicle is considered that occupies some position in absolute space so that its central axes of inertia form a coordinate system. It changes orientation in such a way that the direction of the OX sub o axis of inertia coincides with some fixed direction OK in absolute space by reducing vehicle rotation around the OY axis through angular velocity control consisting of jet engines which produce moments along the principle central axes of the vehicle. Author

N73-21556# Ohio Univ., Athens. Dept. of Electrical Engineering.
ALL-WEATHER, LOW-LEVEL NAVIGATION AND IMPLEMENTATION OF A ONE-WAY RANGING, RANGE-RANGE NAVIGATION SYSTEM Final Semiannual Report, Apr. - Oct. 1972
Nov. 1972 192 p refs
(Contracts DAAB07-68-C-0084; DAAB07-71-C-0156)
(AD-755205; ECOM-0084-F; SAR-6) Avail: NTIS CSCL 17/7

The report is a synopsis of a five-year effort of research and development activities into low-level, all-weather aircraft navigation. Various disciplines supporting radio navigation research were pursued in this work and reflected in the report which include computer simulation, communications, electronics, electromagnetics, digital computer technology, control theory, and mathematics. The scope of the work included tradeoff analysis among competing ideas, optimization of system parameters, alleviation of critical implementation problems, invention of new and/or improved structures for radio navigation purposes, and the synthesis of conceptual ideas which were subsequently simulated, analyzed, implemented in prototype form and experimentally evaluated. Author (GRA)

N73-21557# Mitre Corp., Bedford, Mass.
A NORTH ATLANTIC AIR TRAFFIC ANALYSIS PROGRAM
R. H. Reck Dec. 1972 58 p refs
(Contract F19628-71-C-0002; AF Proj. 4150)
(AD-755910; MTR-2389; ESD-TR-72-328) Avail: NTIS CSCL 01/2

A computer program to analyze air traffic in the North Atlantic Ocean is described. Three program options allow the user to obtain a bird's-eye view of the zone traffic at a specified instant of time, determine the flights which pass through a specified geographic box, and determine the time order and latitude of flights crossing a specified longitude. Typical results showing the instantaneous airborne count, amount of traffic passing through a geographic zone, and number of flights per hour versus time are given for two days in 1972. Data was extracted from the Airline Guide. Author (GRA)

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N73-21558 Arizona Univ., Tucson.
ON-LINE DIGITAL COMPUTER CONTROL OF THE NERVA NUCLEAR ROCKET ENGINE Ph.D. Thesis
Larry Ellis Kendrick 1972 191 p
Avail: Univ. Microfilms Order No. 72-18965

This study considers the problem of on-line digital computer control of the NERVA nuclear rocket engine. NERVA operates in the following manner. Liquid hydrogen is removed from a storage tank by a turbopump and pumped into a nuclear reator. The hydrogen is heated in the reactor and exhausted from the engine nozzle to provide thrust. Energy to drive the turbopump is also derived from the reactor. Design objectives call for a thrust of 75,000 pounds. The physical complexity of the system is reflected in the differential equations description of the engine dynamics in that the describing equations are high order, nonlinear, and tightly coupled. Dissert. Abstr.

N73-21559# National Bureau of Standards, Boulder, Colo. Reactor Radiation Div.
NBS REACTOR: SUMMARY OF ACTIVITIES, OCTOBER 1971 TO SEPTEMBER 1972
Robert S. Carter, ed. Mar. 1973 140 p refs
(NBS-TN-758) Avail: SOD $2.10 domestic postpaid; $1.75 GPO Bookstore

All programs which depend on the NBS reactor are summarized. It covers the period from October 1971 through September 1972. The programs range from the use of neutron beams to study the structure and dynamics of materials through nuclear physics and neutron standards to sample irradiations for activation analysis, isotope production, and radiation effects studies. Author

N73-21560*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
POSTOPERATIONAL EXAMINATION OF AN EXTERNALLY CONFIGURED THERMIONIC CONVERTER
W. M. Phillips 15 Mar. 1973 19 p refs
(Contract NAS7-100)
(NASA-CR-131523; JPL-TM-33-597) Avail: NTIS HC $3.00 CSCL 18I

An externally configured thermionic converter was operated for 200 h. The converter was disassembled and examined to determine internal changes as a result of operation. The metal/ceramic seals and all joints were unaffected by operation. Converter output voltage and operational time were sufficient to produce electrolysis of stabilized zirconia spacers used in the converter. Surface analysis of the electrode surfaces indicated the presence on the tungsten emitter of only oxygen, carbon, and silicon. The niobium collector was, however, 25 to 40% covered with other elements. This coverage represented all elements present within the converter as construction materials other than silicon and tungsten, which were not detected on the collector, and carbon, which was detected only in small amounts. Author

N73-21561*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THERMOELECTRIC OUTER PLANETS SPACECRAFT (TOPS)
1 Apr. 1973 424 p refs
(Contract NAS7-100)
(NASA-CR-131451; JPL-TM-33-589) Avail: NTIS HC $23.25 CSCL 21F

The research and advanced development work is reported on a ballistic-mode, outer planet spacecraft using radioisotope thermoelectric generator (RTG) power. The Thermoelectric Outer Planet Spacecraft (TOPS) project was established to provide the advanced systems technology that would allow the realistic estimates of performance, cost, reliability, and scheduling that are required for an actual flight mission. A system design of the complete RTG-powered outer planet spacecraft was made; major technical innovations of certain hardware elements were designed, developed, and tested; and reliability and quality assurance concepts were developed for long-life requirements. At the conclusion of its active phase, the TOPS Project reached its principal objectives: a development and experience base was established for project definition, and for estimating cost, performance, and reliability; an understanding of system and subsystem capabilities for successful outer planets missions was achieved. The system design answered long-life requirements with massive redundancy, controlled by on-board analysis of spacecraft performance data. Author

N73-21562*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
STUDY OF EXTRATERRESTRIAL DISPOSAL OF RADIOACTIVE WASTES. PART 3: PRELIMINARY FEASIBILITY SCREENING STUDY OF SPACE DISPOSAL OF THE ACTINIDE RADIOACTIVE WASTES WITH 1 PERCENT AND 0.1 PERCENT FISSION PRODUCT CONTAMINATION
R. E. Hyland, M. L. Wohl, and P. M. Finnegan Apr. 1973 41 p refs
(NASA-TM-X-68216; E-7180-Pt-3) Avail: NTIS HC $4.25 CSCL 18G

A preliminary study was conducted of the feasibility of

space disposal of the actinide class of radioactive waste material. This waste was assumed to contain 1 and 0.1 percent residual fission products, since it may not be feasible to completely separate the actinides. The actinides are a small fraction of the total waste but they remain radioactive much longer than the other wastes and must be isolated from human encounter for tens of thousands of years. Results indicate that space disposal is promising but more study is required, particularly in the area of safety. The minimum cost of space transportation would increase the consumer electric utility bill by the order of 1 percent for earth escape and 3 percent for solar escape. The waste package in this phase of the study was designed for normal operating conditions only; the design of next phase of the study will include provisions for accident safety. The number of shuttle launches per year required to dispose of all U.S. generated actinide waste with 0.1 percent residual fission products varies between 3 and 15 in 1985 and between 25 and 110 by 2000. The lower values assume earth escape (solar orbit) and the higher values are for escape from the solar system. Author

N73-21563*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SPACE TRANSPORTATION AND DESTINATION CONSIDERATIONS FOR EXTRATERRESTRIAL DISPOSAL OF RADIOACTIVE WASTE
A. V. Zimmerman, R. L. Thompson, and R. J. Lubick Apr. 1973 41 p refs
(NASA-TM-X-68211; E-7034) Avail: NTIS HC $4.25 CSCL 18G

A feasibility study is summarized of extraterrestrial (space) disposal of radioactive waste. The initial work on the evaluation and comparison of possible space destinations and launch vehicles is reported. Only current or planned space transportation systems were considered. The currently planned space shuttle was found to be more cost effective than current expendable launch vehicles, by about a factor of two. The space shuttle will require a third stage to perform the disposal missions. Depending on the particular mission this could be either a reusable space tug or an expendable stage such as a Centaur. Of the destinations considered, high earth orbits (between geostationary and lunar orbit altitudes), solar orbits (such as a 0.90 AU circular solar orbit) or a direct injection to solar system escape appear to be the best candidates. Both earth orbits and solar orbits have uncertainties regarding orbit stability and waste package integrity for times on the order of a million years. Author

N73-21564# National Bureau of Standards, Washington, D.C. Center for Radiation Research.
PHOTONUCLEAR REACTION DATA, 1973
E. G. Fuller, H. M. Gerstenberg, H. VanderMolen, and T. C. Dunn Mar. 1973 132 p refs
(NBS-SP-380) Avail: SOD HC $2.10 domestic postpaid or $1.75 GPO Bookstore

A brief summary is given of the available data on the gross features of the photonuclear giant resonance. Data are presented in tabular form for all nuclei where measurements have been made. In addition, a comprehensive, annotated data index and bibliography are given which cover experimental data for the field of photonuclear reactions published in scientific and technical journals in the period from 1955 through 1972. Organized by element and isotope, each entry in the index is for a specific reaction reported in a given reference. Information is given on the type of measurement, excitation energies studied, source type and energies, detector type and angular ranges covered for each reaction entry. Author

N73-21565# Colorado Univ., Boulder. Dept. of Engineering Design and Economic Evaluation.
MODELING OF ATOMIC CLOCK PERFORMANCE AND DETECTION OF ABNORMAL CLOCK BEHAVIOR
William A. Ganter Mar. 1973 50 p refs Sponsored by NBS
(NBS-TN-636) Avail: SOD $0.50 as C13.46:636

It is assumed that the nominal performance of an atomic clock can be well characterized by a noise amplitude and a mix of white and flicker pure noise processes. A number of specific kinds of changes are assumed that a clock might encounter. These changes can occur with either sign and with varying magnitudes. The changes considered are a noise amplitude different from nominal, a flicker component in the noise mix which is different from nominal, a step jump in the time counts for a clock and a linear (frequency jump) or quadratic (frequency drift) trend in the time counts for a clock. Detection of a change is accomplished with a multiple sequential test having compound limits. The test is designed to respond quickly to an actual change but to make few incorrect detections (identify the wrong change) or false detections (when no change from nominal operation has occurred). When a change is detected for a clock, the laboratory time scale can be adjusted accordingly for this condition. Author

N73-21566# State Univ. of New York, Stony Brook. Dept. of Earth and Space Sciences.
HIGH ENERGY NUCLEAR INTERACTIONS WITH MATTER AND NUCLEAR PROCESSES IN NATURE Annual Report, 1 Jul. 1971 - 30 Jun. 1972
O. A. Schaeffer 30 Jun. 1972 6 p refs
(Contract AT(11-1)-3080)
(TID-26183) Avail: NTIS

Proton production cross sections were determined for stable and radioactive rare gases for vanadium, barium, uranium, and iron targets. Studies indicate that by the use of a laser beam it is possible to extract the rare gases from sub milligram samples. A new method of counting Cl-36 in the gas phase and CH3Cl was developed and applied to Cl-36 produced by protons in iron targets and in meteorites. Author (NSA)

N73-21567# Atomics International, Canoga Park, Calif.
SNAP REACTOR PROGRAMS Progress Report, May - Jul. 1972
15 Oct. 1972 147 p refs
(Contract AT(04-3)-701)
(AI-AEC-13039) Avail: NTIS

The conceptual design and analyses of the 5-kW(e) ZrH reactor thermoelectric nuclear power system is discussed. Reactor parametric studies were performed to determine the effect of various reactor configurations on the overall system weight and performance. Hydrogen permeation measurements were performed on Hastelloy X cladding tubes. The permeation test procedure was modified to minimize the effects of surface oxidation on the permeation rate of fuel elements. The conceptual configuration of the control drive actuator was established. A system design point was selected for additional study. The net electrical power output is held constant at 5.0 kWe during the 5-y lifetime. The reactor outlet temperature increases from 1140 to 1200 F over the five years to compensate for degradation of the thermoelectric converters. A near minimum weight configuration was selected at 1785 lb with a radiator area of 246 ft. The preferred radiator design has aluminum fins bonded to stainless-steel coolant tubes. Author (NSA)

N73-21568# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
FPMS LIFE TEST Annual Report
L. E. VanBibber Jul. 1972 29 p
(Contract AT(11-1)-3559)
(WANL-3559-1) Avail: NTIS

The SNAP-23A fueled prototype mockup system has been on system thermal and life test since February 1970. It has accumulated 18,700 hours of testing through June 30, 1972 of which 17,070 have been accumulated on life test with the prototype mockup converter PMC-3. On June 30 the system was producing 63 watts at an overall efficiency of 6.1 percent. The fuel power level was 1025 watts corresponding to 5.7 years from the nominal fuel design loading of 1180 watts. During the life test period the system has performed as predicted without any apparent degradation of system components and interfaces. The only change in performance has been that due to fuel decay. Author (NSA)

N73-21569# Teledyne Isotopes, Timonium, Md. Energy Systems Div.
SNAP 19 RTG FOR VIKING LANDER SYSTEM Semiannual Progress Report, 1 Jan. - 30 Jun. 1972
Aug. 1972 230 p refs
(Contract AT(29-2)-2960)
(IESD-2960-53; SAPR-1) Avail: NTIS

The technical activities associated with the development, design and testing of the SNAP 19 Viking RTG were discussed. The major technical efforts included: development of a high temperature electrical receptacle-to-generator housing hermetic seal, development of a fuel capsule helium vent system for venting the radioisotope fuel-produced helium external to the generator housing, testing to determine the effect of Mars surface thermal cycling on generator electrical performance, and design studies for assembly and test of an Engineering ETG. Author (NSA)

N73-21570# Los Alamos Scientific Lab., N.Mex.
NUCLEAR ROCKET REFERENCE DATA SUMMARY
J. D. Balcomb Oct. 1972 13 p Sponsored by AEC
(Contract W-7405-eng-36)
(LA-5057) Avail: NTIS

A brief description of the design and operating characteristics of a nuclear rocket engine is presented. The engine has a mass of approximately 2550 kg and is designed to operate at a specific impulse of 875 s for one hour at a thrust of 73,000 N or at a specific impulse of 860 s for two hours at a thrust of 71,700 N. The startup, shutdown, and cooldown performance characteristics are described. Operating characteristics special to a nuclear engine are summarized including radiation environment, nuclear criticality safety, prestart conditioning, and postrun deadbands. The technology status and proposed development schedule of the engine are discussed. Author (NSA)

N73-21571# Gulf General Atomic, San Diego, Calif.
DEVELOPMENT OF A THERMIONIC REACTOR SPACE POWER SYSTEM Summary Report, 1 Nov. 1971 - 29 Feb. 1972
31 Jul. 1972 264 p refs
(Contract AT(04-3)-840)
(GULF-GA-A-11073) Avail: NTIS

The fabrication and testing programs for UC-ZrC thermionic fuel elements for space power systems are reviewed. NSA

N73-21572# Army Foreign Science and Technology Center, Charlottesville, Va.
OPERATIONAL CHARACTERISTICS OF THE BETA-1 AND BETA-2 ISOTOPIC THERMOELECTRIC GENERATORS
G. M. Fradkin, V. M. Kodyukov, A. I. Ragozinski, N. P. Korotkov, and E. A. Kazakov Jan. 1973 11 p refs Transl. into ENGLISH of unidentified Russian language article
(AD-755834; FSTC-HT-23-1044-72) Avail: NTIS CSCL 10/2

The Beta-1 and Beta-2 experimental isotopic electrical generators, used as power sources for the ARMS-N Automatic Radio Meteorological Station, were created to check out a number of theoretical premises and design features upon which they are based. The Beta-1 and Beta-2 isotopic thermoelectric generators consist of the following basic components: isotopic and thermal units, a thermopile unit, the housing, a biological safeguard, a thermodischarge system, as well as the generation and storage of electrical energy. The experimental operation of the Beta-2 isotopic thermoelectric generator showed that the installation was reliable in its operation and that the design of the generator and the biological safeguard provide the necessary radiation safety-observing the widely accepted rules for operating the covered ion-emission sources and the rules for operation.
Author (GRA)

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics, 20 Meteorology; and 29 Space Radiation.

N73-21573*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ANALYSIS OF NOISE PRODUCED BY AN ORDERLY STRUCTURE OF TURBULENT JETS
Jay C. Hardin Washington Apr. 1973 31 p refs
(NASA-TN-D-7242; L-8843) Avail: NTIS HC $3.00 CSCL 20A

The orderly structure which has been observed recently by numerous researchers within the transition region of subsonic turbulent jets is analyzed to reveal its noise-producing potential. For a circular jet, this structure is molded as a train of toroidal vortex rings which are formed near the jet exit and propagate downstream. The noise produced by the model is evaluated from a reformulation of Lighthill's expression for the far-field acoustic density, which emphasizes the importance of the vorticity within the turbulent flow field. It is shown that the noise production occurs mainly close to the jet exit and depends primarily upon temporal changes in the toroidal radii. The analysis suggests that the process of formation of this regular structure may also be an important contribution of the high-frequency jet noise. These results may be helpful in the understanding of jet-noise generation and in new approaches to jet-noise suppression.
Author

N73-21574*# Scientific Translation Service, Santa Barbara, Calif.
ON THE EFFECT OF CARBON AND COPPER ON THE MAGNETIC PROPERTIES OF IRON AND IRON-SILICON ALLOYS (TRANSFORMER LAMINATIONS) Ph.D. Thesis
Peter Huhse Washington NASA Apr. 1973 72 p refs
Transl. into ENGLISH from the German thesis
(Contract NASw-2483)
(NASA-TT-F-14857) Avail: NTIS HC $5.75 CSCL 20C

The effects of carbon and copper on the magnetic properties of iron and iron-silicon alloys were investigated experimentally and theoretically. The magnetic properties were determined with standard commercial equipment. It appeared that these properties are much more strongly effected by different heat treatment than by a small change in the alloy composition. For similar heat treatement it was possible to observe a dependence of the magnetic properties on the alloy composition both for the iron-silicon-carbon alloys and for the iron-silicon-copper alloys. For the iron-silicon-carbon alloys it was established that they become magnetically softer with increasing addition of silicon and magnetically harder with increasing copper content; as long as the carbon is dissolved or contained in the alloy as cementite. A solubility limit for copper was determined for the iron-silicon-copper alloys. Above this limit the magnetic hardness increases sharply with the precipitated copper, while the dissolved copper only slightly hardens the alloys. Author

N73-21575*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MAGNETIC PROPERTIES OF $Dy_2Ti_2O_7$
D. J. Flood 1973 16 p refs Presented at Am. Phys. Soc. Meeting, San Diego, Calif., 19-22 Mar. 1973
(NASA-TM-X-68219; E-7417) Avail: NTIS HC $3.00 CSCL 20C

Measurements were made of the magnetization, differential magnetic susceptibility, and magnetic entropy of powered samples of $Dy_2Ti_2O_7$. The saturation magnetic moment is 4.7 + or - 0.2 Bohr magnetons per Dy ion, instead of 10 as predicted by Hund's rules. A temperature-independent magnetization is observed in the saturation region. Absolute values of magnetic entropy have been obtained for temperatures from 1.25 to 20 K, in applied fields up to 10.4 tesla. The magnetic entropy approaches a maximum value consistent with a ground-state multiplicity of 2. Low field magnetization and differential susceptibility data show a transition to antiferromagnetism near 1.35 K. A construction of the magnetic specific heat from the zero field entropy shows an anomaly near the same temperature. Author

N73-21576# Northeastern Univ., Boston, Mass. Dept. of Physics.
PHASE DIAGRAM OF A DECORATED ISING SYSTEM
F. Y. Wu Mar. 1973 10 p refs Sponsored in part by NSF
(NUB-2175) Avail: NTIS HC $3.00

The phase diagram of a decorated Ising system is obtained on the basis of the equivalent Ising model. It is shown that various phases arise in different regions of the parameter space.
Author

N73-21577# Cornell Univ., Ithaca, N.Y. Materials Science Center.
HYDROSTATIC PRESSURE STUDIES OF MAGNETIC MODES IN THE FAR INFRARED Ph.D. Thesis
Kent Charles Johnson Aug. 1972 147 p refs
(Contract AT(11-1)-3151)
(COO-3151-12) Avail: NTIS

Measurement of the frequency shifts of far infrared active magnetic modes as a function of applied hydrostatic pressure has permitted determination of the variation of the super-exchange interaction with interionic spacing in MnO, MnF2, and MnF2:Fe(2+). In the pure crystals, the antiferromagnetic resonance was used as the probe of the exchange interaction, while in MnF2:Fe(2+) observation of a localized magnetic impurity mode above the host spin wave band allowed the impurity-host exchange to be monitored. The experiments were performed on crystals maintained at 4.2 K and compressed by pressures up to 7.5 kbar with helium as the pressure transmitting medium. The experimental results were analyzed in terms of the covalent model of superchargers developed by Anderson. The pressure dependence of the covalent parameter was approximated by that of the two-center overlap integrals between wave functions of the completely ionized states. When only covalency between 3rd metal states and 2p, 2s ligand states is considered, the overlap calculations give a result for Y sub m consistently 30% higher than the measured values. Author

N73-21578# Texas Univ., Austin. Center for Particle Theory.
BLACK BODY HEAT CAPACITY AND ACTION AT A DISTANCE ELECTRODYNAMICS
A. M. Gleeson Jun. 1972 17 p refs Presented at 3d Rochester Conf. of Coherence and Quantum Optics, Rochester, N. Y., 21 Jun. 1972
(Contract AT(40-1)-3992)
(ORO-3992-97; CPT-151; Conf-720646-2) Avail: NTIS

The classical theory of matter is discussed with emphasis on the theory of electrodynamics. Starting with the Lagrangian for a system of two equal masses, each with one degree of freedom, the Hamiltonian and equations of motion are obtained for a simple model that contains all the essential features of modern action at a distant formalism. The formalism is applied to classical electricity, magnetism, and black body heat capacity. F.O.S.

N73-21579# Akademiya Nauk URSR, Kiev. Inst. Teoreticheskoi Fiziki.
THEORY OF INCOHERENT REFLECTION OF ELECTROMAGNETIC WAVES FROM PHOTOELASTIC MEDIA, WHICH ARISES FROM FLUCTUATION OF SURFACE WAVES
L. G. Grechko, N. Ya. Kotsarenko, and A. M. Fedorchenko 1972 17 p refs In RUSSIAN; ENGLISH summary
(ITF-72-78-P) Avail: AEC Depository Libraries

The correlation functions for displacements in the case of a semiboundless isotropic elastic medium taking into account the Rayleigh surface waves are obtained. The incoherent reflection coefficient determined by light dispersion on thermal fluctuations of acoustic surface waves is derived (the wave attenuation is disregarded). The case of a normal primary emission drop is analyzed. The numerical estimation shows that the effect under consideration is quite accessible to experimental observation. Author

N73-21580# Danish Atomic Energy Commission, Risoe. Physics Dept.
QUANTUM MECHANICAL OPERATOR EQUIVALENTS USED IN THE THEORY OF MAGNETISM
O. Danielsen and P.-A. Lindgard Mar. 1972 93 p refs
(RISO-259) Avail: AEC Depository Libraries

Two sets of operator equivalents, the Racah operators and the Stevens operators are treated. Their definitions as angular momentum operators, the transformation properties under rotations, the approximate Bose operator expansions, and the mutual connection of the two sets of operators are treated in detail. The information is presented in a number of detailed tables to enable direct use in hand calculations. Author (NSA)

N73-21581# Oak Ridge National Lab., Tenn.
EXPLICIT EXPRESSION FOR THE MAGNETIC FIELD DUE TO A CURRENT LOOP
G. S. McNeilly Dec. 1972 10 p refs
(Contract W-7405-eng-26)
(ORNL-TM-4023) Avail: NTIS

An explicit formula for the magnetic field due to a current loop is given in terms of complete elliptic integrals. Since in many cases a current loop or loops is a close approximation to a finite circular coil, the expression is useful in magnetic field calculations involving circular coils. A program which calculates the expression is included in the appendix. Author (NSA)

N73-21582# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.
RAPID VAPORIZATION OF LIQUID HYDROGEN IN A NONINSULATED RESERVOIR
J.-M. Astruc, Helmut Geipel, and J. Rebiere [1972] 5 p refs In FRENCH Presented at 4th Intern. Cryog. Eng. Conf., Eindhoven, Netherlands, 24 May 1972
(CEA-CONF-2082; Conf-720565-1) Avail: AEC Depository Libraries

A study was made of a 28l capacity liquid hydrogen reservoir container, plunged in water, after rupture of the vacuum seal. Direct contact between the cryogenic liquid and the hot wall was assured by calibre orifices placed in the interior wall. Rough hydrogen vaporization proceeds on the exterior surface of an aluminum wall 4 mm thick, the exterior surface comes in contact with the water at 11 C. The duration of vaporization, wall temperature, thickness of the ice layer, and the flow and pressure of hydrogen were measured in the case of three different artifically created leaks. The thermal exchange coefficients were calculated by different methods. Transl. by E.H.W.

N73-21583# Atomic Energy Establishment, Cairo (Egypt). Dept. of Accelerators and Plasma Physics Research.
DIAMAGNETIC MEASUREMENTS ON THE SHOCK TUBE
T. A. El-Khalafawy, M. M. Masoud, and A. I. Zemskov 1972 20 p refs
(AREAEE-145) Avail: AEC Depository Libraries

Diamagnetic measurements on an electrically driven shock tube are discussed. General conditions of the moving plasma in longitudinal magnetic field interactions are considered. Dependence of the propagation velocity on the initial pressure, deceleration effects, plasma temperature, and plasma pressure are investigated. The role of the different deceleration mechanisms and the effects of magnetic field influence on the shock wave are examined. Author

N73-21584# Leeds Univ. (England). Dept. of Electrical and Electronic Engineering.
ELECTRIC STRENGTH OF A GAS SUBJECTED TO ACCELERATION OR RETARDATION Final Scientific Report, 1 Jan. - 31 Dec. 1972
Albert Ernest Desire Heylen 3 Jan. 1973 20 p refs
(Grant AF-AFOSR-2315-72)
(AD-755848; EOAR-TR-73-02) Avail: NTIS CSCL 20/3

The case of an enclosed volume incorporating electrically stressed parallel plates subjected to mechanical acceleration or deceleration is considered. At atmospheric pressure, the electric strength of the gas is lowered by acceleration but the reduction in strength is lowest when the acceleration is across the electric field direction. Near the Paschen minimum it is possible to increase the strength and thus by judicious choice of variables, the influence of acceleration can be eliminated. Retardation produces the same effect. The values of acceleration required to produce a marked change in strength are attainable in practice. The analogy with space charge effect is noted. Author (GRA)

N73-21585# Naval Research Lab., Washington, D.C. Electronics Branch.
AN ULTRAVIOLET FLASHLIGHT FOR ILLUMINATING FLUORESCENT CHARTS Final Report
B. J. Wilson 23 Jan. 1973 15 p refs
(AD-755435; NRL-7525) Avail: NTIS CSCL 13/1

A flashlight adaptation of an ultraviolet (UV) source has been made with a battery/converter supply powering a mercury vapor lamp. Two D-size common flashlight batteries power a single dc-ac modified Royer inverter whose output drives the UV lamp. The small circular UV fluorescent mercury-glow-discharge lamp is powered by a roughly 250-V square wave. It is eye safe. Illumination is confined to several square inches to preserve security in the presence of visible reradiation from the fluorescent map surface. The continuous operation capability exceeds 10 hr above roughly 50F. Author (GRA)

N73-21586# Naval Ordnance Lab., White Oak, Md.
POLYMER SOUND SPEEDS AND ELASTIC CONSTANTS
Bruce Hartmann and Jacek Jarzynski 22 Dec. 1972 19 p refs
(AD-755695; NOLTR-72-269) Avail: NTIS CSCL 11/9

Sound speed measurements were made on 25 polymers at room temperature and on five of these polymers as a function of temperature. On 15 of the polymers, both longitudinal and shear sound speeds were measured. Using these sound speeds and measured densities, the elastic constants of the polymers were calculated. Author (GRA)

N73-21587# Cornell Univ., Ithaca, N.Y. Lab. of Atomic and Solid State Physics.
CRITICAL EXPONENTS FOR CHARGED AND NEUTRAL BOSE GASES ABOVE LAMBDA POINTS
Shang-Keng Ma 5 Jun. 1972 5 p refs Repr. from Phys. Rev. Letters, v. 29, no. 19, 6 Nov. 1972 p 1311-1314 Prepared in cooperation with Calif. Univ., La Jolla
(Contract N00014-67-A-0077-0010)
(AD-756022) Avail: NTIS CSCL 20/10

Critical behavior and exponents above the Lambda-transition points in charged and neutral Bose systems are examined with emphasis on the correlation of density fluctuations. Exponents are calculated with Wilson's expansion methods for arbitrary d to O(1/m), where d is the dimension and m the number of components of the Bose field. Some results for arbitrary m to O(Epsilon squared) (Epsilon = 4-d) are also obtained. Author (GRA)

N73-21588# Naval Research Lab., Washington, D.C.
NONLINEAR DETECTION OF A LOW-FREQUENCY PLANE WAVE BY A DIRECTIONAL CIRCULAR PISTON BEAM
Interim Report
Peter H. Roger, A. O. Williams, Jr., and James M. Barber 29 Dec. 1972 20 p refs
(AD-755167; NRL-7484) Avail: NTIS CSCL 17/1

Westervelt's prediction (1963) that an acoustic signal of low frequency can be detected by a parametric endfire array--i.e., by nonlinear interaction with a pump beam of high frequency--is analyzed for the case of a plane wave of low frequency incident on a highly directional beam from a circular plane piston used as a pump. The piston beam is centered on the z axis, with which the plane wave makes a small angle psi. To first-order perturbation theory, the z component of particle velocity for the interaction component at the difference frequency is proportional to the product of the piston beam function, as calculated at the difference frequency, and the response function of a truncated endfire array of length z, along the z axis, as calculated at the low frequency. Hence the receiving directivity of the system is determined only by the endfire response function, regardless of the piston's properties. Author (GRA)

N73-21589# Woods Hole Oceanographic Institution, Mass.
BEHAVIOR OF MODIFIED RAY THEORY
James A. Davis Dec. 1972 19 p refs Presented at the 84th Meeting of the Acoustical Soc. of Am., Miami, Fla., 28 Nov. - 1 Dec. 1972
(Contract N00014-70-C-0205; NR Proj. 263-103)
(AD-755460; WHOI-72-89; R2) Avail: NTIS CSCL 20/1

Both modified ray theory and ordinary ray theory can be obtained from the method of stationary phase. Use of a WKB approximation leads to two points of stationary phase and the result is ray theory. Use of a generalized WKB approximation leads to an infinite number of stationary phase points and the result of using the first two is modified ray theory. The degree to which modified ray theory accurately includes frequency dependent diffraction effects depends on the treatment of caustics and inflection points which arise in the modified ray theory field. In sound propagation problems where there is a shadow region the ray theory field may or may not contain a caustic, whereas the modified ray theory field always contains a caustic and in some cases a cusped or higher order caustic. For ranges much less than the shadow boundary range the modified ray theory field approaches the ray theory field. Author (GRA)

N73-21590# Woods Hole Oceanographic Institution, Mass.
PROPAGATION LOSS AS PREDICTED BY RAY THEORY
James A. Davis Dec. 1972 21 p refs Presented at the 83d Meeting of the Acoustical Soc. of Am., Buffalo, 18-21 Apr. 1972
(Contract N00014-70-C-0205; NR Proj. 263-103)
(AD-755459; WHOI-72-88; M1) Avail: NTIS CSCL 20/1

Modified ray theory predicts a frequency dependent distortion of the sound field which is obtained by ordinary ray theory. One qualitative consequence of this distortion is the introduction of a caustic in problems where ray theory predicts a shadow boundary. In order to test this approximate theory and determine the significance of such effects, a computer program has been developed which computes propagation loss for a variety of problems which, while simple, are pertinent to underwater sound propagation. The results of a numerical investigation of propagation loss vs. range are presented as a function of frequency, material properties, and boundary conditions (unbounded, pressure release surface, and rigid boundary). Comparisons are made with ray theory and available exact solutions. Author (GRA)

N73-21591# Naval Ordnance Lab., White Oak, Md.
THE COHERENCE OF SIGNALS, NOISE AND REVERBERATION IN THE SEA
R. J. Urick 10 Nov. 1972 23 p refs Presented at 84th Meeting of the Acoust. Soc. of AM., 28 Nov. - 1 Dec. 1972
(AD-755696; NOLTR-72-279) Avail: NTIS CSCL 20/1

Separated hydrophones in the sea show varying degrees of coherence, or waveform similarity, depending on separation, frequency, and kind of sound observed. Over the past ten years we have measured the phase coherence of different kinds of signals, noise and reverberation between vertically separated hydrophones. Such information is basic for the optimum design of arrays. This paper summarizes these measurements. When plotted against normalized separation, the coherence as measured by the clipped correaltion coefficient is found to lie, as it should, between the value of unity for a plane wave and a curve for isotropic noise; it depends on the vertical angle within which the sound arrives at the two hydrophones. The most coherent sounds observed were signals in covergence zones; the least coherent, the reverberation received from great depths in the deep sea. Author (GRA)

N73-21789* Geological Survey, Washington, D.C.
PHYSICAL AND GEOLOGICAL ASPECTS OF HEILIGENSCHEIN MEASUREMENTS, PART Y
Robert L. Wildey *In* NASA. Lyndon B. Johnson Space Center Apollo 16 Prelim. Sci. Rept. 1972 7 p refs (For availability see N73-21729 12-30)
CSCL 20F

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N73-21592# Illinois Univ., Urbana. Dept. of Physics.
THE LIGHT CONE AND TWO JET STRUCTURE FOR DEEP INELASTIC FINAL STATES
John D. Stack [1972] 26 p refs
(Grant NSF GP-25303)
(ILL-(TH)-73-4) Avail: NTIS HC $3.50

A very general assumption is made about the form of the bilocal operator in a light-cone theory. Using this assumption, it is shown that the secondaries in deep inelastic scattering are produced in two jets, widely separated in rapidity. Finite invariant masses for the two jets dominate. On the basis of qualitative reasoning, it is suggested that this behavior is unlikely to actually occur for deep inelastic scattering on hadrons and that instead, the Bjorken scaling predictions may be violated. An outline is given of requirements on a theory in which the scaling predictions are violated. Author

N73-21593# Illinois Univ., Urbana. Dept. of Physics.
EXCLUSIVE FINAL STATES IN ELECTROPRODUCTION

J. D. Sullivan 1973 43 p refs Presented at Conf. on Recent Advances in Particle Phys., 15-17 Mar. 1973; Sponsored by N. Y. Acad. of Sci. Submitted for publication
(Grant NSF GP-25303)
(ILL-(TH)-73-2) Avail: NTIS HC $4.25

A survey is given of a number of theoretical models which have been used to discuss final hadronic states produced in inelastic electron-hadron scattering. Among these are: (1) exchange models, (2) the multiperipherial model, (3) the vector dominance model, and (4) the parton model. Of special interest, both theoretically and experimentally, is the way in which particular hadronic final states contribute to the well-established scaling property of the total electron-hadron scattering. Present experimental data, while extremely interesting and in some ways puzzling, does not yet favor any one particular theoretical model or point of view. Author

N73-21594*# Institute for Telecommunication Sciences, Boulder, Colo.
CLASSICAL SCATTERING CALCULATIONS FOR DIATOMIC MOLECULES: A GENERAL PROCEDURE AND APPLICATION TO THE MICROWAVE SPECTRUM O2
Uri Mingelgrin Jul. 1972 64 p refs
(NASA Order L-58506)
(NASA-CR-131527; OT/TRER-32) Avail: NTIS MF $0.95; SOD HC $0.60 CSCL 20H

Many properties of gaseous systems such as electromagnetic absorption and emission, sound dispersion and absorption, may be elucidated if the nature of collisions between the particles in the system is understood. A procedure for the calculation of the classical trajectories of two interacting diatomic molecules is described. The dynamics of the collision will be assumed to be that of two rigid rotors moving in a specified potential. The actual outcome of a representative sample of many trajectories at 298K was computed, and the use of these values at any temperature for calculations of various molecular properties will be described. Calculations performed for the O2 microwave spectrum are given to demonstrate the use of the procedure described. Author

N73-21595# Technische Hogeschool. Delft (Netherlands). Lab. voor Aero- en Hydrodynamica.
ON THE DERIVATION OF THE FOKKER-PLANCK AND SMOLUCHOWSKI EQUATIONS FOR DEFORMABLE PARTICLES SUSPENDED IN NEWTONIAN FLUIDS
H. J. Merk May 1973 109 p refs
(WTHD-46) Avail: NTIS HC $7.50

The equations of motion of deformable particles with arbitrary shape and immersed in a Newtonian fluid are considered. It is concluded that the more or less conventional derivation of the Fokker-Planck equation demands for linearized equations of motion, while in the statistical considerations linearization processes have to be applied in the momentum space. It is found that right, nonlinear rheological equations are not consistent with Fokker-Planck and Smoluchowski equations. Since the latter equations are related to stochastic processes of Markoff, the kinetic foundation of nonlinear rheological equations asks for an extension of the kinetic theory to stochastic processes of non-Markoffian character. Author

N73-21596*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TRACE ELEMENT ANALYSIS OF COAL BY NEUTRON ACTIVATION
Dean W. Sheibley 1973 15 p refs Proposed for Presentation at the 166th Natl. Meeting of the Am. Chem. Soc., Chicago, 26-31 Aug. 1973
(NASA-TM-X-68208; E-7390) Avail: NTIS HC $3.00 CSCL 07D

The irradiation, counting, and data reduction scheme is described for an analysis capability of 1000 samples per year. Up to 56 elements are reported on each sample. The precision and accuracy of the method are shown for 25 elements designated as hazardous by the Environmental Protection Agency (EPA). The interference corrections for selenium and ytterbium on mercury and ytterbium on selenium are described. The effect of bromine and antimony on the determination of arsenic is also mentioned. The use of factorial design techniques to evaluate interferences in the determination of mercury, selenium, and arsenic is shown. Some typical trace element results for coal, fly ash, and bottom ash are given. Author

N73-21597# Northeastern Univ., Boston, Mass. Dept. of Physics.
CORRELATION ENERGY OF AN ELECTRON GAS IN THE QUANTUM STRONG-FIELD LIMIT
Gerd Keiser and F. Y. Wu Mar. 1973 9 p refs Sponsored in part by NSF
(NUB-2178) Avail: NTIS HC $3.00

The ground state of an electron gas in an intense magnetic field is studied using a wave function of the product. The correlation factor is taken to be the ground-state solution of a charged Bose gas and a determinant of single particle Landau states. In the quantum strong field limit so that only the lowest Landau state is populated, the correlation energy is computed using the cluster expansion technique and a variational determination of the boson energy. Numerical results obtained are lower than those derived under the random phase approximation. Author

N73-21598# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Neutronenphysik und Reaktortechnik.
INVESTIGATION OF THE ENERGY DEPENDENCE OF W (LOSS OF ENERGY PER ION PAIR) FOR PROTONS IN HYDROGEN, METHANE, AND H2-CH4-MIXTURES IN VIEW OF NEUTRON SPECTRAL MEASUREMENTS WITH RECOIL PROTON PROPORTIONAL COUNTER TUBES BELOW 25 keV
W. Breitung Jun. 1972 58 p refs In GERMAN; ENGLISH summary
(KFK-1623) Avail: AEC Depository Libraries

A method for the destination of neutron spectra is the measurement with proton recoil proporteal counters. A necessary prerequisite to this is the knowledge of the specific energy loss w of protons in the counting gas. The specific energy loss for protons was measured in the commonly used counting gases hydrogen, methane and H2-CH4-mixtures below 25 keV. A comparison with existing publications shows that two energy regions must be distinguished with respect to the accuracy with which w could be measured. Below 10 keV the results deviate from each other so much that the accuracy of 10 percent envisaged in the flux measurement is not guaranted. For energies greater than 10 keV, it can be assumed that w is known with sufficient accuracy in the counting gases to determine the neutron flux by the proton recoil method an error of less than 10 percent. Author (NSA)

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N73-21599 Maryland Univ., College Park.
EXPERIMENTAL COMPARISON BETWEEN TWO MAGNETICALLY CONFINED, HOT ELECTRON PLASMAS Ph.D. Thesis
Charles Peter DeNeef 1972 177 p
Avail: Univ. Microfilms Order No. 72-20788

A single stage, pulsed magnetic mirror compression experiment traps an unneutralized electron cloud with a density of approximately 10 to the 11th power/cu cm and .3 MeV mean energy at the peak magnetic field of 18.5 kG. The hot electron plasma produced by the injection, trapping, and compression of an unneutralized electron cloud is compared with the hot electron plasma produced by the injection, trapping and compression of the plasma from a deuterated titanium washer stack source. On the basis of synchrotron radiation measurements the existence of a hot electron distribution common to the two plasmas is shown. Each of the two plasmas contains a hot electron distribution with approximately the same total number of electrons, the same mean energy, and the same shape, and each plasma remains trapped for more than 20 msec. The properties of the hot electron distribution common to the two plasmas are isolated by studying the unneutralized hot electron plasma.
Dissert. Abstr.

N73-21600 Maryland Univ., College Park.
INTERPRETATION OF SIGNALS FROM A CYLINDRICAL LANGMUIR PROBE IN A STREAMING LASER-PRODUCED PLASMA Ph.D. Thesis
Stephen Barrett Segall 1972 235 p
Avail: Univ. Microfilms Order No. 72-20261

The applicability of the cylindrical Langmuir probe to the diagnosis of the properties of streaming, laser-produced plasmas is investigated. The regime in which probe measurements can be made is defined, and the relation of the electrostatic probe to other means of plasma diagnostics for laser-produced plasmas is explained. A theory to explain the current characteristic for a probe in a laser-produced plasma is developed. First the theory for a probe in a stationary plasma is analyzed to develop a stationary analog to the flowing plasma case. A simplified general theory is then used to reexamine several fundamental concepts of probe theory and the behavior of the probe for various changes of plasmas and probe parameters. Relations applicable to the case of a probe in a high velocity flowing plasma are developed and used to modify the Langmuir theory for a probe in a collisionless flowing plasma. Dissert. Abstr.

N73-21601 Maryland Univ., College Park.
ENHANCED FAR INFRA-RED RADIATION FROM A THETA PINCH PLASMA Ph.D. Thesis
Cecil A. Chin-Fatt 1972 95 p
Avail: Univ. Microfilms Order No. 72-20785

A non-thermal spectrum of far infra-red radiation was observed, covering a wavelength range of approximately 0.4 mm to 2 mm, emitted by the turbulent helium plasma of a theta pinch with a strongly diffusive magnetic piston, at a peak intensity that is at least three orders of magnitude greater than that expected of an equivalent thermal plasma. Line emission and magnetic probe studies in addition to the temporal development and the observed two-banded structure of the enhanced nonthermal spectrum, support our interpretation of this far infra-red emission to be direct evidence of two nonlinear radiation phenomena, involving the interactions of longitudinal electron waves with plasma inhomogeneities and with themselves and resulting in bremsstrahlung radiation. A theoretical estimate, based on a fluid plasma model, gave fair agreement with the observed intensity of the far infra-red radiation. Dissert. Abstr.

N73-21602 California Univ., San Diego.
AN INVESTIGATION OF LOW DENSITY PLASMA SHOCK WAVES IN AN EXPANDING DISCHARGE Ph.D. Thesis
Harold Alan Davis 1972 166 p
Avail: Univ. Microfilms Order No. 72-19718

Plasma waves launched into a low density, photo-ionized, magnetized, argon plasma were studied. The shock waves were generated by an inverse pinch discharge, an expanding discharge as opposed to the more conventional contracting discharges normally used to study shock waves. The driving current of this device initially flows in the region near the insulator, which is transiently filled with a relatively high density (30 m Torr) of neutral gas just prior to the initiation of the discharge. As this current layer expands, it acts as a piston, driving shocks into the low density region ahead of it. Initially the experimental volume is filled with a uniform axial magnetic field of 1500 G. The diagnostic techniques employed included Kerr cell photography of the plasma luminosity, magnetic and floating electric probing, Thompson scattering at ruby laser light at low alpha to obtain both electron temperature and density, and the measurement of spectroscopic line intensity profiles to infer ion velocities. Dissert. Abstr.

N73-21603 California Univ., Los Angeles.
PARALLEL MAGNETIC MULTIPOLE CONFINEMENT OF A MAGNETIC FIELD-FREE PLASMA Ph.D. Thesis
Rudolf Limpaecher [1972] 105 p
Avail: Univ. Microfilms Order No. 72-20454

A new multimagnetic mirror plasma device is described. The walls of this cylindrical 86-liter box are lined with 1252 permanent magnets to form a series of parallel broken line cusp geometry. Since the magnetic field falls of exponentially the interior is essentially magnetic field free, even though Bmax (at the walls) is 1800 gauss. The argon, helium, hydrogen, or deuterium plasma is produced by electron emission. Strong evidence exists that the ions are contained both magnetically as well as electrostatically. The electrostatic fields, which are maintained by the plasma electron and emission electron interaction with the magnetic multipole field, drastically reduce the ion cusp losses. With this multipole structure, high density quiescent collisionless plasmas can be produced with any size and any geometry.
Dissert. Abstr.

N73-21604 California Univ., San Diego.
STRUCTURE OF A LARGE AMPLITUDE STATIONARY HYDROMAGNETIC DISTURBANCE IN A COLLISIONLESS PLASMA Ph.D. Thesis
Mohamad Ali Mahdavi 1972 157 p
Avail: Univ. Microfilms Order No. 72-19720

Structure of a shock-like hydromagnetic disturbance in a collisionless plasma was studied. The current sheet of an Inverse Pinch Discharge driven into a low density magnetized plasma was used to generate the shock wave. Argon at a static pressure of 2 x 10 to the 13th power torr was used as a filling gas. A certain amount of Argon gas was puffed into the discharge region prior to firing of the energy banks to ensure uniform breakdown of the gas. Preionization of the low density ambient gas was achieved by intense UV radiation from the piston plasma (current sheet of the pinch). Diagnostic techniques used were electric and magnetic field probes, light scattering and spectroscopy. Electron densities and temperatures in the post and preshock regions were measured by light scattering. Streaming velocities of the ions were determined by the measurement of Doppler shift of spectral lines. Electron temperature in the post-shock plasma was also determined by the ratio of spectral line intensities. Dissert. Abstr.

N73-21605 Maryland Univ., College Park.
SYNCHROTRON RADIATION FROM A MAGNETICALLY CONFINED HOT ELECTRON PLASMA Ph.D. Thesis
Soe-Mie Foeng Nee 1972 189 p
Avail: Univ. Microfilms Order No. 72-20260

The spectrum of the synchrotron radiation emitted by the electron cloud produced in a pulsed magnetic mirror compression experiment was measured in a wavelength region from 3.0 cm to 0.3 mm using three independent detector systems. The measured spectra agree with the theoretical spectra calculated using a distribution function derived from a relativistic Maxwellian distribution function that conserves the magnetic moments of the trapped electrons during magnetic compression of the electron cloud. This agreement demonstrates that the electron cloud is compressed adiabatically and that electrons are not lost during the decay of the magnetic field. The analytical expressions of this distribution function and its generalization to the three-dimensional case are derived. Single particle effects on the measured spectrum of synchrotron radiation are also investigated.
Dissert. Abstr.

N73-21606 Stanford Univ., Calif.
CHARGED PARTICLE TRANSPORT IN TURBULENT ASTROPHYSICAL PLASMAS Ph.D. Thesis
Charles Edward Newman, Jr. 1972 79 p
Avail: Univ. Microfilms Order No. 72-20719

The effect of electromagnetic fluctuations, or plasma turbulence, on the motion of the individual particles in a plasma is investigated; two alternative methods are used to find a general equation governing the time-evolution of a distribution of charged particles subject to both an external force field and the random fields of the fluctuations. It is found that, for the high-temperature, low-density plasmas frequently encountered in the study of astrophysics, the presence of even a small amount of turbulence can have a very important effect on the behavior of the plasma. Two problems in which turbulence plays an important role are treated in detail. First, the contribution to electrical and thermal conductivities by the turbulence is calculated. Second, the problem of a distribution of relativistic electrons being stochastically accelerated by plasma turbulence in addition to emitting synchrotron radiation is discussed.
Dissert. Abstr.

N73-21607 Princeton Univ., N.J.
EFFECTS OF PARALLEL WAVELENGTH ON THE COLLISIONAL DRIFT INSTABILITY Ph.D. Thesis

Leland Glenn Schlitt 1972 88 p
Avail: Univ. Microfilms Order No. 72-18787

An extensive investigation of the dependence of drift wave characteristics upon parallel wavelength in collisional potassium Q-machine plasmas is presented. The experiment was performed on Q-1 device modified to permit variation of plasma column length and thus parallel wavelength. Results are compared with a two fluid slab model theory which includes the effects of parallel resistivity and thermal conductivity for electrons and Larmor radius, collisional viscosity, and motion parallel to the magnetic field for ions. Quantitative agreement between experiment and theory to within a factor of 2 is demonstrated for the detailed parametric dependences of drift wave properties (instability onset, complex frequency, and oscillation amplitude) on parallel wavelength, magnetic field, and density.

Dissert. Abstr.

N73-21608 Illinois Univ., Urbana.
THE EXPERIMENTAL STUDY OF WAVE-WAVE COUPLING PROCESSES IN A BEAM PLASMA SYSTEM Ph.D. Thesis
James Shih-Tsih Chang 1972 92 p
Avail: Univ. Microfilms Order No. 72-19806

The wave-wave coupling processes in a cold beam cold plasma system have been investigated under conditions such that nonlinear wave-particle effects are negligible. A low density mono-energetic beam in the energy range of 15 to 16 keV was premodulated at two frequencies, and injected into the afterglow of a discharge in neon. The interaction between these two launched waves and their difference frequency was investigated and at low wave amplitudes was found to be in general agreement with the theory of the three wave decay instability. At larger wave amplitudes, a strong remixing of the three waves occurred which gave rise to satellite waves. Measurements of the spatial evolution of these satellite waves and their dependence on the modulation power and difference frequency are presented.

Dissert. Abstr.

N73-21609# Maryland Univ., College Park.
PROCESSES AND MEASUREMENTS IN AN ABNORMAL NEGATIVE GLOW PLASMA Ph.D. Thesis
Ashok Kumar Kaul 1972 174 p
Avail: Univ. Microfilms Order No. 72-20251

A stable dc discharge system using a brush cathode, and capable of generating a negative glow of useful dimensions, has been described. Measurements of electron densities and temperatures have been made under steady state conditions along the axis of the glow, using a 1 mil cylindrical Langmuir probe. Electron and ion densities are found to satisfy quasineutrality for the negative glow plasma with the electron temperature first decreasing with increasing pressure from about 1500 K to 650 K, and then increasing again to about 2000 K at a pressure of approximately 1 torr. A theoretical model has been presented to explain the observed densities and temperatures, and in particular, the behaviour of the electron temperture.

Dissert. Abstr.

N73-21610*# Avco-Everett Research Lab., Everett, Mass.
RESEARCH IN PLASMA PHYSICS Final Technical Report
Feb. 1973 70 p refs
(Contract NASw-2302)
(NASA-CR-131533) Avail: NTIS HC $5.50 CSCL 20I

Three aspects of barium ion cloud dynamics are discussed. First, the effect of the ratio of ion cloud conductivity to background ionospheric conductivity on the motion of barium ion clouds is investigated and compared with observations of barium ion clouds. This study led to the suggestion that the conjugate ionosphere participates in the dynamics of barium ion clouds. Second, analytic work on the deformation of ion clouds is presented. Third, a linearized stability theory was extended to include the effect of the finite extent of an ion cloud, as well as the effect of the ratio of ion cloud to ionospheric conductivities. The stability properties of a plasma with contra-streaming ion beams parallel to a magnetic field are investigated. The results are interpreted in terms of parameters appropriate for collisionless shock waves. It is found that this particular instability can be operative only if the up-stream Alfven Mach number exceeds 5.5. Author

N73-21611*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SIMULTANEOUS IN SITU ELECTRON TEMPERATURE COMPARISONS USING ALOUETTE 2 PROBE AND PLASMA RESONANCE DATA
Robert F. Benson Feb. 1973 15 p refs Submitted for publication
(NASA-TM-X-66205; X-621-73-70) Avail: NTIS HC $3.00 CSCL 20I

The electron temperatures deduced from Alouette 2 diffuse resonance observations are compared with the temperature obtained from the Alouette 2 cylindrical electrostatic probe experiment using data from 5 mid-to-high latitude telemetry stations. The probe temperature is consistently higher than the diffuse resonance temperature. The average difference ranged from approximately 10% to 40% with the lower values occurring at the lowest altitudes sampled (near 500 km) and at high latitudes (dip latitude greater than 55 deg), and the larger values occurring at high altitudes and lower latitudes. The discrepancy appears to be of geophysical origin since it is dependent on the location of the data sample. The present observations support the view that the often observed radar backscatter - probe electron temperature discrepancy is also of geophysical origin. Author

N73-21612*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ELECTRON AVALANCHE STRUCTURE DETERMINED BY RANDOM WALK THEORY
Gerald W. Englert Washington Apr. 1973 42 p refs
(NASA-TN-D-7224; E-7074) Avail: NTIS HC $3.00 CSCL 20I

A self-consistent avalanche solution which accounts for collective long range Coulomb interactions as well as short range elastic and inelastic collisions between electrons and background atoms is made possible by a random walk technique. Results show that the electric field patterns in the early formation stages of avalanches in helium are close to those obtained from theory based on constant transport coefficients. Regions of maximum and minimum induced electrostatic potential phi are located on the axis of symmetry and within the volume covered by the electron swarm. As formation time continues, however, the region of minimum phi moves to slightly higher radii and the electric field between the extrema becomes somewhat erratic. In the intermediate formation periods the avalanche growth is slightly retarded by the high concentration of ions in the tail which oppose the external electric field. Eventually the formation of ions and electrons in the localized regions of high field strength more than offset this effect causing a very abrupt increase in avalanche growth. Author

N73-21613*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
STEADY-STATE HOT-ION PLASMA PRODUCED BY CROSSED ELECTRIC AND MAGNETIC FIELDS
Donald R. Sigman and John J. Reinmann Washington Apr. 1973 16 p refs
(NASA-TM-X-2783; E-7303) Avail: NTIS HC $3.00 CSCL 20I

Results of initial diagnostics on the Lewis Research Center hot-ion-plasma source (HIP-1) are reported. The mirror-contained plasma was heated by applying a radial electric field similar to that used in the ORNL burnout experiments. An electrostatic neutral particle analyzer was used to make a parametric study of ion energy distributions in both hydrogen and euterium plasmas. Ion temperatures as high as 2 keV were measured in plasmas with electron densities greater than 10 to 12th power/cu cm. The performance of the device was found to be extremely sensitive to a magnetic field. There are indications that ion heating was reduced when the size of the Larmor orbit was larger than the region of a strong radial electric field. Author

N73-21614# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.
LOWER HYBRID PLASMA HEATING
S. S. Pesic Jul. 1972 40 p refs
(EUR-CEA-FC-657) Avail: AEC Despository Libraries

The damping of quasi-longitudinal plasma oscillations in the lower hybrid frequency range was investigated. The complete

dispersion equation governing small amplitude quasi-longitudinal oscillations in hot homogeneous anisotropic plasmas was solved numerically for a wide range of plasma parameters. The temporal damping rates of stable eigen oscillations and the spatial damping rates of externally drive plasma waves are given. The straight-line orbit approximation, the effect of distant collisions on the ion resonant interaction, and the limits of linearity imposed by the distortion of the distribution function in the resonant velocity region are discussed. The results obtained indicate the way energy is preferentially given to the perpendicular motion of the ion.
NSA

N73-21615# Joint Publications Research Service, Washington, D.C.
TRANSFORMATION OF ELECTROMAGNETIC WAVES INTO LONGITUDINAL OSCILLATIONS IN A NONHOMOGENEOUS PLASMA IN THE PRESENCE OF PERFECTLY CONDUCTING SURFACE
V. V. Demchenko, V. V. Dolgopolov, and A. Ya. Omelchenko Oct. 1972 15 p refs Transl. into ENGLISH from the Russian Report KHFTI-70-54 Prepared for AEC
(AEC-tr-7346; KHFTI-70-54) Avail: NTIS

It is shown that the electromagnetic waves caused by initial perturbation on the boundary of a semi-infinite plasma in the presence of a perfectly conducting surface, during the time determined by the width of the transition zone between the plasma and vacuum, are converted to longitudinal oscillations concentrated in the transition layer between the plasma and vacuum and propagating along the plasma density gradient.
Author (NSA)

N73-21616# Joint Publications Research Service, Washington, D.C.
THEORY OF WAVE INTERACTIONS IN THE BEAM-PLASMA SYSTEMS IN MAGNETIC FIELDS
A. M. Korsunskii, N. S. Repalov, and N. A. Khizhnyak Oct. 1972 11 p refs Transl. into ENGLISH from the report KHFTI-70-75 Prepared for AEC
(AEC-tr-7355; KHFTI-70-75) Avail: NTIS

The plasma-electron beam system can be used in devices intended for creating intensive waves of a space charge which, in turn, can be used for accelerating ions. The process of ion acceleration imposes rigid requirements on the form of the accelerating fields. Therefore, the problems of the stability of the spectrum of these fields are extremely important. A nonlinear region of plasma oscillations with an electron beam placed in a uniform magnetic field was investigated. Regions of stable and unstable regimes were found, and the dynamics of energy exchange between individual waves was studied. Author (NSA)

N73-21617# Princeton Univ., N.J. Plasma Physics Lab.
PARAMETRIC INSTABILITY AND ITS INDUCED HEATING
T. K. Chu 1972 15 p refs Presented at 1st Topical Conf. on RF Heating of Plasmas, Lubbock, Tex., 6-8 Jul. 1972
(Contract AT(11-1)-3073)
(Conf-720705-5) Avail: NTIS

Laboratory experiments having high frequency excitation electric fields near omega sub pe are reviewed. Effects of the inhomogeneity of plasmas are discussed, and the potential use of parametric instability in plasma heating is assessed.
Author (NSA)

N73-21618# Joint Publications Research Service, Washington, D.C.
BREMSSTRAHLUNG OF RELATIVISTIC PLASMA
V. N. Tsytovich [1972] 22 p refs Transl. into ENGLISH from the Russian report NP-18758 Prepared for AEC
(AEC-tr-7348; NP-18758) Avail: NTIS

A general theory of bremsstrahlung that takes into account the processes of spontaneous and induced emission and the influence of emission processes on plasma particle distribution (quasi-linear effects) is formulated. Author (NSA)

N73-21619# Northwestern Univ., Evanston, Ill.
NUMERICAL SIMULATIONS OF PLASMAS WITH SMOOTHING IN PHASE SPACE AND FILTERING IN TIME Progress Report, 1 Feb. - 30 Sep. 1972
J. Denavit 30 Sep. 1972 11 p refs
(Contract AT(11-1)-2200)
(COO-2200-1) Avail: NTIS

The research is directed toward the development of numerical simulation methods for collisionless plasmas using (a) periodic smoothing in phase space and (b) filtering in time, and the application of these methods to physical problems of current interest to controlled thermonuclear research. During the past eight months, research on the project was concentrated on Part (a). A computer program was developed and tested to simulate plasma dynamics with self-electric and -magnetic interactions, and a numerical study of trapping effects on the evolution of whistler wave trains, using this computer program, was initiated. Author (NSA)

N73-21620# Joint Publications Research Service, Washington, D.C.
INTERACTION OF PLASMA STREAMS WITH STATIONARY, AXIALLY SYMMETRIC MAGNETIC FIELDS
Yu. S. Azovskii, I. T. Guzhovskii, and N. A. Khizhnyak [1972] 101 p refs Transl. into ENGLISH from Russian report KHFTI-70-50 Prepared for AEC, Washington, D. C.
(AEC-tr-7354; KHFTI-70-50) Avail: NTIS

Theoretical and experimental investigations of the interaction of plasma currents with axisymmetric magnetic fields are discussed. A model of a small compressible plasma bunch is used for the theoretical description. Deformation, induced azimuthal current, heating and electric polarization of the plasma during interaction with an axisymmetric magnetic field are examined within the framework of this model; unmagnetized and magnetized bunches are examined. Hall current in a stationary incompressible flow is examined in magnetohydrodynamic approximation. The interactions of plasma flows with magnetic fields of a solenoid, short coil, two coils hooked up head-to-head, and a space-periodic magnetic field are subjected to experimental analysis, and the changes of the basic parameters of plasma flow (density, velocity, radius, temperature, induced current, and electric field of polarization) are determined. The theoretical and experimental results are compared. Author (NSA)

N73-21621# Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
THEORETICAL AND EXPERIMENTAL STUDIES OF MICROWAVE INTERACTION EFFECTS IN A HYPERSONIC AIR PLASMA
D. W. Boyer and S. N. Andre Oct. 1972 147 p refs Prepared for Sandia Labs., Albuquerque, N. Mex. Sponsored by AEC
(SC-CR-72-3164) Avail: NTIS

The results of a theoretical and experimental study of microwave transmission through the aerodynamically-generated air plasma about a blunt wedge in the shock tunnel are presented. The effects of the plasma environment on propagation loss, antenna reflection coefficient (magnitude and phase), pattern and the coupling between adjacent antennas were investigated and the results compared with numerical predictions. The operating frequencies were 2.6 and 4.0 GHz. Complementary interferometer measurements throught the shock-layer plasma were made at 9.2 GHz and independent measurements of the electron temperature and number density profiles over the antennas were performed using thin-wire electrostatic probes. Author

N73-21622# Joint Publications Research Service, Washington, D.C.
SPECTRA OF MAGNETIC PULSATIONS OF NONISOTHERMAL PLASMA
M. A. Livshits and V. N. Tsytovich AEC Nov. 1972 10 p refs Transl. into ENGLISH of Akad. Nauk SSSR, Fiz. Inst., Moscow, report NP-19291 Sponsored by AEC
(AEC-tr-7379; NP-19291) Avail: NTIS

Nonlinear interactions and the spectra of magnetic pulsations of isothermal, turbulent plasma have been previously investigated by. Under conditions of nonisothermal plasma, ionacoustic oscillations arise both at low frequencies (collision free Alfven and MHD waves), and at high frequencies (spiral waves). The spectrum of the turbulence associated with the magnetic pulsations is the subject of a theoretical study in both of the indicated frequency regions. NSA

N73-21623# Joint Publications Research Service, Washington, D.C.

SPECTROSCOPIC EXAMINATION OF THE PARAMETERS OF A TURBULENT PLASMA

A. B. Berezin, L. V. Dubovoi, B. V. Lyublin, and D. G. Yakovlev Dec. 1972 12 p refs Transl. into ENGLISH from Russian report NP-19262 Sponsored by AEC
(AEC-tr-7375; NP-19262) Avail: NTIS

A study was made of the parameters of a plasma in a highly turbulent state. Two branches of the oscillations in the discharge are isolated. The basic characteristics of these oscillations are estimated by the shape of the H beta hydrogen spectral line profile. In this experiment the intensity of the E fields of the turbulent pulsations was approximately equal 6 kg/cm. The turbulent level and the degree of anisotropy of the oscillations were given. Author (NSA)

N73-21624# Lyon Univ. (France). Inst. de Physique Nucleaire.

SOME RESULTS ABOUT ION SOURCES IN INHOMOGENEOUS MAGNETIC FIELDS

T. Tauth, G. Hadinger, G. Hadinger-Espi, and M. Bajard Jul. 1972 12 p refs
(LYCEN-7250) Avail: AEC Depository Libraries

Mathematical models are developed to estimate the yield of multicharged ion sources. A system of differential equations is used to describe the microscopic behavior of the various ions. If certain relations of MHD theory are taken into consideration, together with general laws, it is possible to deduce the ion and electron concentration distributions together with other fundamental parameters such as cross sections, pressures, etc. The ion formation density corresponding to each charge state is determined for various magnetic field configurations, using the results obtained and a Monte Carlo method. NSA

N73-21625# Lyon Univ. (France). Inst. de Physique Nucleaire.

EQUATIONS DESCRIBING A QUASINEUTRAL HEAVY ION PLASMA CONFINED IN A MAGNETIC FIELD. APPLICATION TO ION SOURCES

T. Tauth Jul. 1972 18 p refs In FRENCH; ENGLISH summary
(LYCEN-7208) Avail: AEC Depository Libraries

Two methods based on the analysis of macroscopic phenomena are presented: a method describing the elementary processes occurring in an isolated plasma containing multicharged heavy ions on a second method using the MHD equations and electrodynamics to explain certain characteristics of the discharge column. The formalisms presented enable the connection between the structure of the plasma and the confining magnetic field to be appreciated. NSA

N73-21626# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.

OPERATIONAL PROPERTIES OF A HELICAL MICROWAVE SOURCE UNDER HIGH DENSITY PLASMA AND INTENSE MAGNETIC FIELD CONDITIONS

R. Cano, G. Lisitano, and B. Zanfagna Jul. 1972 16 p refs In FRENCH; ENGLISH summary
(CEA-EUR-FC-652) Avail: AEC Depository Libraries

The main features of a helical type microwave plasma source are presented. The microwave power is maintained constant. The vacuum system has a basic pressure 0.000001 torr: hydrogen and argon are used in the region 0.0001 to 0.01 torr. The magnetic field intensity is varied. Plasma densities of between 10 to the 11th power and 10 to the 13th power cm/3 and electron temperatures of between 1 and 15 eV are obtained. The degree of ionization was estimated to vary between 1% and 30%. NSA

N73-21627# Max-Planck-Institut fuer Plasmaphysik, Garching (West Germany).

PROCEEDINGS OF THE SECOND TOPICAL CONFERENCE ON PULSED HIGH-BETA PLASMAS

W. Lotz, ed. Jul. 1972 281 p refs Conf. held 3-6 Jul. 1972
(IPP-1/127; Conf-720710) Avail: AEC Depository Libraries

Abstracts and papers presented at the conference on pulsed high beta plasmas are reported. Topics discussed include plasma pinch, stability and equilibrium, and shock waves. F.O.S.

N73-21628# Max-Planck-Institut fuer Plasmaphysik, Garching (West Germany).

TRANSIENT PROCESSES DUE TO INTERACTION OF SHOCK PRODUCED PLASMA FLOWS WITH MAGNETIC FIELDS: A THEORETICAL INVESTIGATION

F. Sardei Aug. 1972 104 p refs In GERMAN; ENGLISH summary
(IPP-4/41) Avail: AEC Depository Libraries

Transient processes due to the interaction of plasma flows behind strong shock waves with transverse magnetic fields are theoretically investigated. After the model is described, basic problems relating to the formation of a reflected shock are analytically treated. The detailed development of the entire interaction process is then numerically evaluated, and these values are compared with experimental results. It is shown that, under certain conditions, the origin in space and time of the reflected shock can already be determined with relatively simple calculations. Under general conditions, on the other hand, the development of the entire interaction process can only be obtained by numerically solving the complete mathematical problem. The plots of the calculations allow all essential phenomena involved in the interaction process to be recognized and interpreted. In particular, the influence of the interaction parameter and the ionization energy on the flow pattern is clarified. Author (NSA)

N73-21629# Max-Planck-Institut fuer Plasmaphysik, Garching (West Germany).

OBSERVATION OF HIGH ORDER STIMULATED RAMAN-ANTISTOKES RADIATION AND ITS ROLE IN THE INITIAL PHASE OF PLASMA PRODUCTION BY LASERS

H. Mennicke Jul. 1972 52 p refs In GERMAN; ENGLISH summary
(IPP-4/40) Avail: AEC Depository Libraries

A new model for the production of the first free electrons in a laser-produced hydrogen plasma is presented. According to this model, light of strongly enhanced quantum energy, compared with the quantum energy of the input laser light, is produced by high-order stimulated Raman-antiStokes scattering during the initial phase of the laser-matter interaction. Production of the first free electrons is then achieved by photoionization due to the high-order Raman-antiStokes radiation. Possibilities for dissociation of hydrogen molecules are also briefly discussed. In corresponding experiments, solid hydrogen, deuterium, and nitrogen targets were irradiated with high-intensity ruby laser light. Raman-antiStokes emission was observed spectroscopically for N2 up to the 12th, D2 up to the 10th, and H2 up to the 7th order. Time-resolved intensity measurements of the transmitted laser light, the Raman light, and the original laser light show that the Raman processes occur just before breakdown is observed. Author (NSA)

N73-21630# Max-Planck-Institut fuer Plasmaphysik, Garching (West Germany).

MACROSCOPIC EQUILIBRA OF RELATIVISTIC ELECTRON BEAMS IN PLASMAS

G. Kueppers, A. Salat, and H. K. Wimmel Jul. 1972 30 p refs
(IPP-6/111) Avail: AEC Depository Libraries

Macroscopic equilibria of relativistic electron beams in plasmas, with return current and with or without an external magnetic field parallel to the beam, are investigated in cylindrical geometry. Bennet-type identities and general solutions are derived, and special examples are considered, in particular, low net current, quasi-neutral configurations. A general expression for the current screening factor is obtained. Because of screening, relaxed versions of the Alfven-Lawson conditions determine whether beam propagation is possible. Only equilibria with zero total charge and nonzero total net current and beam profiles without sharp boundary can be obtained from the equations and boundary conditions used. Author (NSA)

N73-21631# Max-Planck-Institut fuer Plasmaphysik, Garching (West Germany).

HCN LASER SOURCE FOR COHERENT SCATTERING FROM WAVES IN STATIONARY PLASMAS

O. Gehre Jul. 1972 29 p refs In GERMAN; ENGLISH summary
(IPP-4/39) Avail: AEC Depository Libraries

Coherent scattering from plasma waves is a useful tool for diagnostics in experiments on plasma confinement and heating. In the density range 10 to the 11th power to 10 to the 14th

power cu/cm and for temperatures of some eV to 1 keV, which includes today's stellarator- and Tokamak-type plasmas, a source in the far-infrared is necessary. The 337-micron line of the HCN laser with a cw power around 100 mW is found to be usable if a high sensitive whisker detector in a heterodyne mode of operation is used for the detection of the scattered light. The construction and working of an HCN laser intended for a scattering experiment are described. Author (NSA)

N73-21632# Kernforschungsanlage, Juelich (West Germany). Inst. fuer Kernverfahrenstechnik.
CONSTRUCTION AND TEST OF A DEVICE FOR PRODUCTION OF HOLLOW CYLINDRICAL CLUSTER BEAMS OF HYDROGEN
H. Burghoff and A. R. Neugebauer Feb. 1972 37 p refs In GERMAN; ENGLISH summary
(KFK-1610) Avail: AEC Depository Libraries

It has been shown previously that a hollow cylindrical beam of nitrogen clusters can be produced by expansion of nitrogen gas out of a ring shaped nozzle cooled by liquid nitrogen. An electrical discharge along this beam produces a plasma of corresponding shape. Since plasmas of the heavy hydrogen isotopes in configurations of this kind may be of interest to produce intense neutron flashes by nuclear fusion it was decided to build a device for production of hollow cylindrical cluster beams of hydrogen. The design, construction, and test of a liquid hydrogen cooled cluster generator that produces a pulsed cluster beam of 40 mm i.d. and a pulse length of several milliseconds is described. Author (NSA)

N73-21633# Commissariat a l'Energie Atomique, Limeil-Brevannes (France). Centre d'Etudes.
INFLUENCE OF COLLISIONS ON THE INCOHERENT SCATTERING SPECTRUM OF A NON-EQUILIBRIUM INHOMOGENEOUS ABSORBING PLASMA
Bernard Meyer Aug. 1972 36 p refs In FRENCH
(CEA-R-4351) Avail: AEC Depository Libraries

The study starts from P. Waldteufel's theory which deals with the effect of collisions on the scattering of an electromagnetic wave in a partially ionized gas. It is applied to fully ionized plasmas, taking into account different kinds of collisions between charged particles. A method is given for numerical resolution of the plasma dispersion function, and results are deduced from final Waldteufel's equations when counterstreaming ions and electrons with various temperature ratios are assumed. Diffusion spectra are obtained for dense, inhomogeneous, absorbing, and even out-of-equilibrium plasma, such as laser-created plasmas. The influence of collisions in terms of observation angle and drift velocity is studied. Author (NSA)

N73-21634# Aix-Marseilles Univ. (France).
APPLICATION OF KINETIC GAS THEORY TO PLASMA PHYSICS AND THE DYNAMICS OF GALAXIES Ph.D. Thesis
J. P. Petit 1972 199 p refs In FRENCH
(FRNC-TH-247) Avail: AEC Depository Libraries

The parameters of a non-Lorentzian plasma are calculated from the Boltzmann equation. Gravitational instability in a Maxwellian medium is studied. A three-dimensional model of a self-gravitational stellar system is obtained by introducing a particular Schwarzchild solution into the Vlasov equation. The rotation curves obtained are in agreement with the results of observations for the case of galaxies. The behavior of interstellar space with respect to gravitational instability is analyzed. The structures of different types of galaxies are explained. The electrothermal instability in Hall and Faraday generators were studied. The calculation of the critical Hall parameter and the rate of growth of the instability is extended to treat the case of partially ionized plasma. The possibility of using closed cycle conversion is discussed. NSA

N73-21635# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics and Fusion Research.
EXPERIMENTS ON MAGNETOACOUSTIC OSCILLATIONS IN A ROTATING PLASMA WITH SUPERIMPOSED HF-HEATING
M. Bures and E. Tennfors Dec. 1972 35 p refs Sponsored by Swed. Atomic Res. Council and Bank of Swed. Tercentenary Fund.
(TRITA-EPP-72-34) Avail: NTIS HC $3.75

Radial magnetoacoustic eigenoscillations were excited in a rotating plasma to investigate the possibilities of using frequency and damping time for diagnostics. Experiments were carried out with hydrogen and deuterium plasmas. In both cases, the energy balance was varied by means of superimposed high frequency heating. The relation between the oscillation characteristics and macroscopic plasma parameters was studied theoretically for an infinitely long cylindrical plasma shell, both in the homogeneous case and when the temperature is allowed to vary across the plasma. It was shown that the eigenfrequency of the oscillations is a measure of the mass density and the geometry of the hot fully ionized plasma core. Damping time was determined by the cool partly ionized boundary regions and cannot easily be interpreted in terms of the temperature of the core. However, it is clear from the results that damping time increases considerably when high-frequency heating is applied. Author (ESRO)

N73-21636# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics and Fusion Research.
BETA LIMITATION OF ROTATING PLASMAS
B. Lehnert 30 Jan. 1973 20 p refs
(TRITA-EPP-73-01) Avail: NTIS HC $3.00

Experiments with a rotating plasma device having a large radial ratio have shown the voltage to be limited to values much lower than those predicted by the critical velocity phenomenon at the end insulators. A possible explanation of this behavior is provided by the centrifugal expansion instability at a critical beta value, before the velocity limit was reached. Results not only agree with the theory on this particular mode of instability but also provide additional support to earlier conclusions regarding stability of impermeable plasmas boundary by limiters.
Author (ESRO)

N73-21637# Illinois Univ., Urbana. Coordinated Science Lab.
QUENCHING OF THE BEAM-PLASMA INSTABILITY BY MODE MIXING AT A DENSITY DISCONTINUITY
H. Boehmer, E. A. Jackson, and M. Raether Nov. 1972 37 p refs
(Contracts DAAB07-72-C-0259; DAAB07-67-C-0199)
(AD-755658; R-592; UILU-ENG-72-2254) Avail: NTIS CSCL 20/9

Experiments on the spatial instability of a beam-plasma system led to the observation that the instability is quenched when irradiated by high power microwaves. It is conjectured that this effect is due to a local decrease in plasma density in the irradiated region. A theoretical model is detailed that explains the salient features of the observed effect. Auxiliary measurements on a system with a controlled density gradient are presented that give strong support for the proposed mechanism. Author (GRA)

N73-21638# Avco-Everett Research Lab., Everett, Mass.
PRODUCTION OF HIGH DENSITY UNIFORM PLASMAS FOR ADVANCED MHD GENERATOR AND ELECTRIC LASER DESIGN Annual Progress Report, period ending 30 Nov. 1972
R. M. Patrick 30 Nov. 1972 34 p
(Contract F44620-70-C-0023; AF Proj. 9752)
(AD-755892; AFOSR-73-0278TR) Avail: NTIS CSCL 20/9

The use of an electron beam to produce a non-self-sustaining electric discharge has been applied to a number of different gases. Electron loss rate processes have been measured in N2, He and CO, as well as mixtures of He, N2 and CO2. The addition of H2O vapor to these gases has resulted in a new type of discharge instability which has not been previously observed. This instability is expected to exist under certain conditions in any preionized gas discharge in which electrons are lost predominantly by electron-neutral dissociative attachment, or by any process whose cross section is an increasing function of electron energy. It has been observed in pure CO2 and He-CO2 electron beam discharges. Theoretical understanding of this instability is important in possible applications of the electron beam discharge to MHD generators, MHD lasers and high-power gas lasers. Author (GRA)

N73-21639# Massachusetts Inst. of Tech., Cambridge. Francis Bitter National Magnet Lab.
DEVELOPMENT OF BROADBAND SOFT X-RAY SOURCES

AND DETECTORS AND THEIR APPLICATIONS Final Report
B. Lax and C. E. Chase Dec. 1972 101 p refs
(Contract F44620-71-C-0002; AF Proj. 9763)
(AD-755845; AFOSR-72-2435TR) Avail: NTIS CSCL 20/9

A theoretical and experimental study of pulsed soft X-ray sources and detectors was carried out. It was shown that electron temperatures and confinement time of laser-produced plasmas are substantially increased by application of high magnetic fields. Theoretical design of an X-ray laser was demonstrated. Calibration of channel electron multiplier detectors was extended out at 0.6 micrometer. Design of a complete spectrometric system with real-time computer analysis, suitable for study of pulsed X-ray sources is described. Author (GRA)

N73-21640# Boston Coll., Chestnut Hill, Mass. Dept. of Physics.
LARGE AMPLITUDE WAVES IN A COLLISIONAL PLASMA WITH AND WITHOUT A MAGNETIC FIELD
Pradip M. Bakshi May 1972 23 p refs
(Contract F19628-71-C-0078; AF Proj. 8608)
(AD-755388; AFCRL-72-0292; SR-4) Avail: NTIS CSCL 20/9

Exact non-linear wave solutions have been obtained for a cold collisional plasma described by one-fluid equations of motion. By a suitable change of variables the equations become linear and hence easily solvable for the case of constant collision frequencies. The oscillation frequency is slightly reduced, but the maximum attainable field amplitude is almost unaltered. The wave profile is steepened and grows exponentially with a scale distance of the order of the wave displacement in a collision time. The essentially non-linear problem of velocity dependent collisions leads to a slower, algebraic growth. Author (GRA)

N73-21447 Joint Publications Research Service, Arlington, Va.
INTERACTION OF THE NITROGEN OF THE FURNACE ATMOSPHERE WITH AN ARGON PLASMA ARC
O. F. Aksenov, V. M. Antipov, R. S. Bobrovskaya, M. M. Krutyanskiy, and G. N. Okorokov *In its* Selected Transl. on Met. 19 Mar. 1973 p 15-21 refs (For availability see N73-21445 12-17)

N73-21756* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
SUBSATELLITE MEASUREMENTS OF PLASMA AND ENERGETIC PARTICLES
K. A. Anderson (Calif. Univ., Berkeley), L. M. Chase (Calif. Univ., Berkeley), R. P. Lin (Calif. Univ., Berkeley), J. E. McCoy, and R. E. McGuire (Calif. Univ., Berkeley) *In its* Apollo 16 Prelim. Sci. Rept. 1972 6 p refs (For availability see N73-21729 12-30)
CSCL 20I

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N73-21641 National Lending Library for Science and Technology, Boston Spa (England).
EFFECT OF SUBSTRATE TOPOGRAPHY ON THE PROPERTIES OF CYLINDRICAL Ni-Fe THIN FILMS
A. A. Edigaryan, K. A. Egiyan et al 20 Dec. 1972 19 p refs Transl. into ENGLISH from Izv. Akad. Nauk. Arm. SSR, Fiz. (Yerevan), v. 6, no. 1, 1971 p 34-42 In ENGLISH and RUSSIAN (NLL-LTI-746-1370-(9022.401)) Avail: Natl. Lending Library, Boston Spa, Engl.: 2 NLL photocopy coupons

The effects of the substrate on the magnetic properties of cylindrical films were investigated. Irregularities were created by anodic etching of the substrate. Substrate topography, after different forms of etching, was determined by electron microscopy using carbon replicas. It is shown that under corresponding conditions of etching it is possible to obtain a uniform hilly topography with an amorphous structure. The magnetic properties of the films depend on the topography, in particular, the coercive force and dispersion anisotropy increase with an increase in the roughness. The recording and failure currents simultaneously increase. Author

N73-21642 Minnesota Univ., Minneapolis.
STUDY OF FLUX-FLOW NOISE IN TYPE 2 SUPERCONDUCTORS Ph.D. Thesis
Shu-wei Shen 1972 148 p
Avail: Univ. Microfilms Order No. 72-20148

Flux-flow noise in type 2 superconductors is investigated theoretically and experimentally. The observed noise turns out to be shot noise as expected from the assumption that the flux-flow voltage is generated by independently drifting flux bundles. Bundle size as large as 100 to 10,000 are found in vanadium foils depending on the biased condition. The experiment shows qualitative agreement with the theory. Dissert. Abstr.

N73-21643 Illinois Univ., Urbana.
STEADY-STATE FIELD DRIVEN CONDUCTION IN SEMICONDUCTORS WITH TRAPPING Ph.D. Thesis
Harry Richard Zwicker 1972 123 p
Avail: Univ. Microfilms Order No. 72-19967

An accurate method for determining theoretically and for differentiating between solutions for space-charge-neutral (SCN) and space-charge-limited (SCL) conduction in a heavily compensated, semiconductor p-i-n diode is reported. The scope of this work is confined by the assumption of strictly field-determined carrier transport processes, i.e., by the complete neglect of diffusion. The general analytical formulation follows a unified, logical path, which begins with a consideration of the steady-state space charge neutral recombination kinetics of the semiconducting or insulating material of the i region. Three problems are discussed in detail: (1) why conduction in all well-compensated semiconductor materials is SCN at low injection levels, (2) where and why the two possible regimes of SCL conduction may occur, and (3) the overall physics of SCN conduction in the p-i-n diode, relating these processes finally to other earlier models for conduction in both SCN and SCL regimes of the J-V characteristic. Dissert. Abstr.

N73-21644 Washington Univ., Seattle.
MAGNETO-OPTIC KERR EFFECTS IN GADOLINIUM METAL Ph.D. Thesis
James Lorenzo Erskine 1972 105 p
Avail: Univ. Microfilms Order No. 72-20863

Magneto-optic Kerr effects were investigated in nickel, gadolinium, and dysprosium at temperatures between 10 K and 300 K in the 1 to 5 eV energy range. Polycrystalline and single crystal samples prepared by vacuum evaporation were studied in situ under ultra-high vacuum conditions. The complete conductivity tensor for isotropic polycrystalline gadolinium samples was evaluated from experimental data. An intraband theory of magneto-optic effects is developed and used to subtract from the experimental results, the intraband contribution. The remaining interband contribution is discussed using a band model based on existing band calculations. Analysis of the data using this model predicts an interesting effect which is an inversion of spin density in the conduction bands. The results also suggest that magneto-optic Kerr effects will provide a useful method of studying d-bands in rare-earth metals. Dissert. Abstr.

N73-21645 Syracuse Univ., N.Y.
LITHIUM-MULTIVALENT ACCEPTOR IMPURITY INTERACTION IN GERMANIUM Ph.D. Thesis
Paul LoVecchio 1972 98 p
Avail: Univ. Microfilms Order No. 72-20352

The interaction in germanium between lithium and the multivalent acceptor impurities Zn, Hg, Au Ni and Cu was studied through the influence of lithium on the location and concentration of the states within the forbidden gap associated with these multivalent impurities. Hall, photoconductive spectral response, and resistance versus temperature measurements are made. Investigation of the interaction of lithium with the impurities Mn, Ni, Su was made possible by the development of a technique employing an In-Li alloy as the medium from which lithium diffusion proceeds into the doped germanium. The impurity pair Zn-Li was found to have an acceptor activation energy of 11.0 plus or minus .4 MeV, somewhat larger than the 9.5 MeV

value reported for this level. Study of the Mn-Li interaction has led to evidence of a new impurity-pair state within an activation energy of 0.10 plus or minus 01 eV. Dissert. Abstr.

N73-21646 Stanford Univ., Calif.
THE LOW TEMPERATURE OPTICAL ABSORPTION OF SOME UNUSUAL INTERMETALLIC COMPOUNDS Ph.D. Thesis
Howard Clayton Kirsch 1972 79 p
Avail: Univ. Microfilms Order No. 72-20710

The optical absorption properties of some interesting metallic materials were measured in the near infrared and visible portions of the spectrum. The results of these measurements were interpreted in terms of the electronic structure of the materials. In this way, quantitative data concerning electron parameters are obtained. The absorption measurements were carried out at cryogenic temperatures using a calorimetric system. A diffused silicon resistance thermometer was employed as the sensitive element of the calorimeter. The electrical and thermal properties of this device make it useful for calorimetric measurements which require good sensitivity and relatively fast response times. The thermometer action in the silicon thermal element occurs in a thin surface layer into which impurity atoms have been diffused in a controlled manner. Dissert. Abstr.

N73-21647 Rochester Univ., N.Y.
MICROWAVE TRANSMISSION THROUGH GALLIUM SINGLE CRYSTALS Ph.D. Thesis
Robert Francis Milligan 1972 228 p
Avail: Univ. Microfilms Order No. 72-18826

The transmission of microwave radiation through thin (0.07 to 0.5 mm) gallium single crystals is studied at 1.3 K by using a two cavity, microwave transmission spectrometer. At this temperature, the conduction electron mean-free-path is much greater than the sample thickness, and as the dc magnetic field is swept, sample size-effect oscillations dominate the transmission spectrum, These Gantmakher-Kaner oscillations in the transmitted electric field were observed for dc magnetic field in all three principal planes of gallium. The Gantmakher-Kaner oscillation periods are compared with the periods of the analogous Sondheimer oscillations in the dc magnetoresistance of gallium. The microwave transmission experiment appears to be more (less) sensitive to electrons with small (large) values than does the dc experiment. Dissert. Abstr.

N73-21648 Rochester Univ., N.Y.
THE RESISTIVE TRANSITION OF A SUPERCONDUCTOR Ph.D. Thesis
Gordon Albert Thomas 1972 173 p
Avail: Univ. Microfilms Order No. 72-18841

Experiments testing the limits of applicability and the systematic breakdown of the mean field theory of superconductivty are discussed. The electrical resistance is used as a probe of the theory in a diversified study dealing with four interrelated aspects of the general problem. In the first part the linearized, time dependent Ginzburg-Landau (GL) theory is investigated through experiments on the fluctuation conductivity of Al thin films in large electric fields above the transition temperature T sub c. An experimental innovation important to the success of this study is the use of vacuum insulated, thin film superconductor thermometers to allow precision temperature control in the presence of large heat fluxes. In section two, one-dimensional microstrips are studied, and it is found that, although the simple linearized theory breaks down close to T sub c the theory can be extended into the region near T sub c by the self-consistent inclusion of the fourth order term in the GL free energy. Dissert. Abstr.

N73-21649 Drexel Univ., Philadelphia, Pa.
MICROWAVE MEASURED MAGNETIC HYSTERESIS IN SUPERCONDUCTING NIOBIUM FILMS Ph.D. Thesis
Wing Joseph SooHoo 1972 179 p
Avail: Univ. Microfilms Order No. 72-19544

Studies were made on the microwave surface impedance of thin niobium films subjected to a slowly varying dc magnetic field normal to their planes. The films, between 100 A and 650 A thick, were electron-beam evaporated at 10 to the minus 8th power torr. onto unheated micro-cover glass substrates. They show a superconducting dc resistance transition temperature which decreases from 9 K above 240 A thickness to 5.5 K at 116 A. Mean free path calculations indicate that the thinner films do not conform to the Sondheimer theory of film conduction. The temperature coefficient of resistance is positive for all films but is smaller for the thinner films. Using a 10 GHz bridge, the complex reflection coefficient for the film, which was placed so as to completely cover a cross section of the waveguide, was measured. The electromagnetic boundary problem for this configuration was solved and the transmission line analysis was carried through. Dissert. Abstr.

N73-21650 Delaware Univ., Newark.
THEORY OF AMORPHOUS SEMICONDUCTORS: ELECTRONIC STATES IN THE UNDULATORILY-GRADED BAND-GAP MODEL Ph.D. Thesis
George Bernard Inglis 1972 63 p
Avail: Univ. Microfilms Order No. 72-20525

A model is proposed for amorphous semiconductors which displays intermediate range order with undulations in composition or structure on a scale within the range of validity of the graded band-gap concept. Electronic states well within the allowed bands are determined by a perturbative analysis starting with Bloch states; states near the band edges, by a modification of an effective mass analysis previously developed for monotonically graded mixed crystals. The band edges are identified as the loci of the classical turning points of the effective mass functions for the localized states. Thermal activation from the band edge troughs and tunneling between troughs are considered. From the model and analysis it appears possible to explain field dependent conductivity, to account for the persistence of the optical band-gap on conversion from crystalline to amorphous semiconductors, and to predict sensitivity of electronic properties to doping in some amorphous semiconductors. Dissert. Abstr.

N73-21651 California Inst. of Tech., Pasadena.
SPIN WAVE RESONANCE IN FERROMAGNETIC FILMS Ph.D. Thesis
Christopher H. Bajorek 1972 136 p
Avail: Univ. Microfilms Order No. 72-17637

The objective of this investigation has been a theoretical and experimental understanding of ferromagnetic resonance phenomena in ferromagnetic thin films, and a consequent understanding of several important physical properties of these films. Significant results have been obtained by ferromagnetic resonance, hysteresis, torque magnetometer, He ion backscattering, and X-ray fluorescence measurements for nickel-iron alloy films. Taking into account all relevant magnetic fields, including the applied, demagnetizing, effective anisotropy and exchange fields, the spin wave resonance condition applicable to the thin film geometry is presented. On the basis of the simple exchange interaction model it is concluded that the normal resonance modes of an ideal film are expected to be unpinned. The possibility of nonideality near the surface of a real film was considered by means of surface anisotropy field, inhomogeneity in demagnetizing field and inhomogeneity of magnetization models.
Dissert. Abstr.

N73-21652 Rochester Univ., N.Y.
ELECTRON TUNNELING THROUGH THIN SEMICONDUCTOR FILMS Ph.D. Thesis
Gerrit Lubberts 1972 123 p
Avail: Univ. Microfilms Order No. 72-18823

An investigation of thin, evaporated semiconductor films as tunnel barriers between tin electrodes is reported. The tunneling characteristics of CdSe, CdS, CdS sub x Se sub (1-x), ZnSe, and CdTe barriers were examined experimentally. Longitudinal optical (LO) phonon structure in the current-voltage (I-V) curve, characteristic of the semiconductor layer, was observed and studied. Cadmium selenide films deposited on 115 C substrates were studied most extensively as tunnel barriers. The zero-bias conductance to these junctions was found to depend exponentially on the CdSe thickness. Junctions with CdS sub x Se sub (1-x) and ZnSe as barriers were also examined. Superconducting energy gap measurements, as well as the shape of the I-V curve, indicated measurements, was the conduction mechanism in all these functions. Dissert. Abstr.

N73-21653# Northeastern Univ., Boston, Mass. Dept. of Physics.
CRITICAL EXPONENTS OF THE MODIFIED F MODEL
F. Y. Wu, H. J. Brascamp (Inst. des Hautes Etudes Sci., Bures-sur-Yvette), and H. Kunz (Inst. des Hautes Etudes Sci., Bures-sur-Yvette) Feb. 1973 7 p refs Sponsored by NSF, Neth. Organ. for Pure Sci. Res., Swiss Natl. Found. for Sci. Res.
(NUB-2172) Avail: NTIS HC $3.00

Critical exponents of an eight-vertex model, the modified F model, are obtained. The result beta = 1/4, gamma = gamma prime = 3/2, eta = 1/2, nu = nu prime = 1 together with the established indices alpha = alpha prime = 0 obey the scaling relations. Author

N73-21654# Kernforschungsanlage, Juelich (West Germany). Inst. fuer Festkoerperforschung.
COMMENTS ON THE PAPER: EVIDENCE FOR A NEW PHASE OF SOLID He-3
H. Horner and L. H. Nosanow [1972] 9 p refs
(COO-1569-96) Avail: NTIS

Data on the solidification pressure of He-3 below 3 mK are analyzed, and the suggestion that solid He-3 undergoes a first order phase transition to a new unprecedented entropy phase is rebutted. Instead, it was concluded that the system undergoes a lambda transition to an ordered magnetic phase. Calculations are presented which show a qualitative picture of the entropy and heat capacity of He-3 in the neighborhood of the transition from the experimental data. E.H.W.

N73-21655# Minnesota Univ., Minneapolis. School of Physics.
COMMENT ON THE POSSIBLE NEEL TEMPERATURE OF SOLID He-3
E. D. Adams (Fla. Univ., Gainsville) 1972 6 p refs Sponsored in part by NSF
(Contract AT(11-1)-1569)
(COO-1569-97) Avail: NTIS

A calculation of the effect of the conjectured three-body exchange on the possible Neel temperature of solid He is made. A value of 2.24 mK is obtained from P sub v (T) data, whereas susceptibility data indicate 2.9 mK. These calculations indicate that three-body exchange may lead to the occurrence of the transition above 2.0 mK, the previously expected value. Author

N73-21656# Minnesota Univ., Minneapolis. School of Physics and Astronomy.
PAIR-FIELD SUSCEPTIBILITY OF SUPERCONDUCTORS
J. T. Anderson (Stanford Univ., Calif.), R. V. Carlson, A. M. Goldman, and H-T Tan (Malaya Univ.) 1972 12 p refs Presented at 13th Intern. Conf. on Low Temp. Phys., Boulder, Colo. 20 Aug. 1972
(Contract AT(11-1)-1569)
(COO-1569-91; Conf-720833-20) Avail: NTIS

Current-voltage characteristics were measured in Al/AlO lead tunneling junctions biased from a constant current source. Quasi-particle currents were computed. The linear variation of the reciprocal of the square root of the dynamic conductance with temperature indicates that the dominant tunneling mechanism is specular transmission of electrons. Dc Josephson current, peak current, peak voltage, and magnetic field dependences were determined. Author (NSA)

N73-21657# Minnesota Univ., Minneapolis. Inst. of Technology.
EXPERIMENTAL AND THEORETICAL STUDIES IN SOLID STATE AND LOW TEMPERATURE PHYSICS Annual Progress Report, 1972
Sep. 1972 31 p refs
(Contract AT(11-1)-1569)
(COO-1569-93) Avail: NTIS

Research projects in solid state and low temperature physics are reported. The generalized susceptibility or pair-field susceptibility of superconductors above the critical temperature, the specific heat of superconducting films in the vicinity of the transition, and the electrical conductivity due to fluctuations in refractory compounds are discussed. The properties of quantum liquids and crystals are described. The development of a temperature-variable, wide-frequency-range probe for the measurement of hyperfine resonances in magnetically ordered materials is examined. Experiments with liquid helium isotopes to study superfluid flow through fine channels were conducted. Author

N73-21658# Case Western Reserve Univ., Cleveland, Ohio.
SOLID STATE PHYSICS PROGRAM Annual Progress Report
Nov. 1972 30 p refs
(Contract AT(11-1)-623)
(COO-623-190) Avail: NTIS

The status of seven problems in thin film physics, ten in cohesive and dielectric properties, and three in solid state theory is outlined. Some especially significant results are presented. Spin-wave calculations of spin-1/2 amorphous ferromagnet indicated a depletion of the high-frequency and a corresponding enhancement of the low frequency density of states, resulting in a reduction of the spontaneous magnetization and the Curie temperature. Additional progress was made in the question of the existence of band gaps in electronic states in amorphous materials. High-accuracy dielectric constant measurements were carried out for a large number of materials including MgO, Al2O3, fused silica, and single crystal quartz. Many samples from different suppliers were measured and indicate that a low loss at a given temperature does not necessarily indicate high purity. The pressure and temperature derivative of the dielectric constants of the alkaline earth fluorides give agreement with the recent calculations. Author

N73-21659# Case Western Reserve Univ., Cleveland, Ohio.
SOLID STATE PHYSICS PROGRAM. GROWTH EFFECTS THIN NICKEL FILMS
R. W. Springer Nov. 1972 136 p refs
(Contract AT(11-1)-623)
(COO-623-183; TR-79) Avail: NTIS

The intrinsic stress of vacuum deposited 2000 A nickel films was examined and correlation between the microstructure and the measured stress was found. The cantilever plate technique for measuring the stress using a microbalance was analyzed in detail. The bending equations were slightly revised from the former closed form approximations used in the past. Linear bending theory was shown to be adequate for the bending arising from the stressed film. The temperature problems associated with this technique were examined and adverse effects were minimized. No bending due to thermal gradients was observed. Stress from early stages of film growth was recorded accurately for the first time. Author (NSA)

N73-21660# Brookhaven National Lab., Upton, N.Y.
COMPARATIVE STUDY OF SUPER-CONDUCTING COMPOSITE CONDUCTORS WITH FILAMENTS OF A-15 COMPOUNDS
M. Suenaga and W. B. Sampson [1972] 5 p refs Presented at the 4th Intern. Conf. on Magnet Technol., Upton, N. Y. Sponsored by AEC
(BNL-17222; CONF-720908-16) Avail: NTIS

Composite superconductors consisting of fine filaments of Nb3Sn, V3Ga, and V3Si in bronze matrices (Cu-Sn, Cu-Ga, and Cu-Si, respectively) were made by the solid state diffusion method. The conductors have identical geometry and consist of 19 filaments approximately 25 micrometer diameter filaments in a 0.25-mm diameter wire. The superconducting properties of these composite wires are compared as well as their susceptibility to mechanical damage. Author (NSA)

N73-21661# Brookhaven National Lab., Upton, N.Y.
OPTIMIZATION OF GAS-COOLED SUPERCONDUCTING MAGNET LEADS. A METHOD FOR GENERAL MATERIALS
C. L. Goodzeit 18 Sep. 1972 13 p refs Sponsored by AEC
(BNL-17233) Avail: NTIS

A method is presented for calculating the length to area ratio of current leads for superconducting magnets that will minimize the heat loss caused by the lead. The method does not assume that the material obeys the Wiedemann-Franz relation; therefore, calculations can be made for ultrahigh purity metals. Sample calculations for such materials are made, and it is shown that it is possible to effect a refrigeration saving over that required for W-F materials. Author (NSA)

N73-21662# Case Western Reserve Univ., Cleveland, Ohio.
SOLID STATE PHYSICS PROGRAM. THE DIELECTRIC PROPERTIES OF SEVERAL INSULATORS
C. Andeen, J. Fontanella, and D. Schuele Nov. 1972 22 p refs

(Contract AT(11-1)-623)
(COO-623-182; TR-78) Avail: NTIS

The 300 K, 1000 Hs dielectric constant of several insulators was measured to an accuracy of 0.01% by the method of substitution (two-fluid method). The results for different kinds of commercially available fused silica show variations of up to 1%. This spread is attributable to the presence of impurities, with water being particularly important. Several samples of naturally occurring crystalline quartz were studied, and, while values of the dielectric for different samples of y-cut and z-cut specimens were quite uniform, the values for the x-cut samples showed a rather wide spread, thus indicating the presence of impurities once again. As a first attempt at determining the level of impurities causing the variation in constant, several samples of 0.55% to 1.26% europium doped CaF2 were measured. The results of these measurements, the first quantitative measurements of the effects of impurities on the dielectric constant are that the dielectric constant is increased by about 1.5% for the various concentrations of CaF2: Eu studied and the effect seems to be isotropic. Author

N73-21663# Cornell Univ., Ithaca, N.Y. Materials Science Center.
FLUX MOTION AND PINNING IN A TYPE 2 SUPERCONDUCTOR M.S. Thesis
A. G. Putz Aug. 1972 123 p refs
(Contract AT(30-1)-4060)
(COO-3169-11; Rept-1849) Avail: NTIS

Earlier experimental results on degradation and recovery of the lattice in deformed niobium crystals are investigated. Voltage-current hysteresis curves when the current is swept up and down are compared. The results are discussed in terms of a theoretical model. NSA

N73-21664# Cornell Univ., Ithaca, N.Y. Materials Science Center.
SCALING LAWS FOR FLUX PINNING IN HARD SUPERCONDUCTORS
E. J. Kramer 1972 41 p refs Sponsored by AEC
(COO-3169-13) Avail: NTIS

For all hard, high field superconductors examined to date, there is a maximum in the pinning force density as a function of the reduced magnetic field. Recent data on the temperature dependence of pinning in Nb3Sn, Nb-25% Zr and a Nb-Ti alloy, which exhibit the peak effect, are analyzed to show that similar scaling laws are obeyed by these materials. All presently available evidence indicates, however, that the reduced field at which the maximum occurs, as well as the height and shape of this maximum, can be altered by metallurgical treatment. Apparently weak pinning defects or widely spaced ones, produce a small peak at high reduced magnetic field whereas strong, closely spaced pins produce a large peak at low reduced magnetic field. A model which predicts these metallurgical effects, as well as the scaling laws is proposed. Author (NSA)

N73-21665# Cornell Univ., Ithaca, N.Y. Dept. of Materials Science and Engineering.
EFFECT OF FLUX LINE LATTICE HISTORY ON THE CRITICAL CURRENT IN NIOBIUM
Marvin Steingart, A. G. Putz, and E. J. Kramer 1972 25 p refs
(COO-3169-14) Avail: NTIS

The critical current in a plastically deformed Nb single cyrstal was shown to vary with the method of formation of the flux line lattice (FLL). The largest critical currents were observed when the FLL was formed by cooling the sample from above Tc (H). Passing a current through the sample during the cooling process, in the same direction as it was subsequently swept, increased sub Ic by up to 60%. Decreases in Ic, with the V-I characteristic asymptotically approaching the characteristic after-flux flow could be induced by slowly cycling the current at zero voltage. The size of the decrease was found to be dependent on the number of cycles and, especially for negative current excursions, on the amplitude of these excursions. A model is proposed to account for these observations. Author (NSA)

N73-21666# California Inst. of Tech., Pasadena. W. M. Keck Lab. of Engineering Materials.
STUDY OF DISLOCATION MOBILITY AND DENSITY IN METALLIC CRYSTALS Annual Summary Report, period ending Jul. 1972
T. Vreeland, Jr., R. E. Villagrana, and K. M. Jassby Jul. 1972 10 p refs
(Contract AT(04-3)-767)
(CALT-767-P-3-27; ASR-10) Avail: NTIS

The current status of research on dislocation mobility and density in metallic crystals is presented, and a summary of the work accomplished since the last reporting period is given. The research has as its objective a first principle understanding of dislocation origin and behavior. The experimental phase of the work is directed toward measurements of the response of isolated dislocations or groups of dislocations to stresses applied under controlled conditions. The dislocations are observed by X-ray topography, transmission electron microscopy, and etch-pit methods. The theoretical phase applies solid state theories to predict the strength of the interactions between moving dislocations and lattice phonons, electrons, and crystal defects. The results of studies on Cu, Pb, and Zn are reported. NSA

N73-21667# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
MAGNETIC INSTABILITIES IN HARD SUPERCONDUCTORS OF THE SECOND KIND AND THEIR CONSEQUENCES Ph.D. Thesis - Paris Univ., Orsay
Daniel Rappanello Aug. 1972 248 p refs In FRENCH
(CEA-N-1552) Avail: AEC Depository Libraries

It is shown that magnetic instabilities in Type-2 superconductors may be detected from measurements of the admissible currents in the material. Such currents were measured and calculations on instabilities were made. Stability criteria associated with the optimum performance of superconducting filaments were established for different magnetic conditions. A preliminary interpretation of the training phenomenon is given. Author (NSA)

N73-21668# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
ELECTRONIC DENSITY OF STATES IN THE WEAIRE MODEL OF AN AMORPHOUS SOLID
W. John 1972 6 p refs Submitted for publication
(JINR-E4-6589) Avail: AEC Depository Libraries

A compact and simple derivation for the density of state formula of Thorpe and Weaire is given, which describes the density of state of a one-band Hamiltonian with an overlap parameter. F.O.S.

N73-21669# Oak Ridge National Lab., Tenn. Solid State Div.
NEUTRON SCATTERING INVESTIGATION OF BOISE-EINSTEIN CONDENSATION IN SUPERFLUID He-4
H. A. Mook, R. Scherm, and M. K. Wilkinson Aug. 1972 8 p refs Presented at 13th Intern. Conf. on Low Temperature Phys., Boulder, Colo., 20 Aug. 1972 Sponsored by AEC
(Conf-720833-10) Avail: NTIS

Measurements were made on a triple axis spectrometer at a constant scattering angle of 135 and a momentum transfer of 14.33 A/1. The results of the measurements are shown for He-4 at 1.2 K and 4.2 K. The data were all normalized to one run which represents about 20 minutes counting time per point. NSA

N73-21670# Brookhaven National Lab., Upton, N.Y.
VACUUM SYSTEMS FOR SUPERCONDUCTING STORAGE RINGS
J. W. Bittner and H. J. Halama 28 Sep. 1972 5 p refs Sponsored by AEC
(BNL-17239) Avail: NTIS

Based on present knowledge, the warm vacuum chamber appears to have many advantages such as simpler single wall construction, fewer welds, well tested components, smaller thermal stresses and higher conductance. Most significant perhaps is the experience with ISR at CERN which shows that the proposed warm system will work. Its only disadvantage is the increase in cost of a slighty larger aperture superconducting magnet. There are, however, two areas which require a good deal of experimental work, namely: development of methods to achieve clean surfaces and low desorption coefficients in Al and Cu pipes when bombarded by approximately 1 keV ion, and design of a

cryosorption pump to be used between magnets inside the dewar. Author (NSA)

N73-21671# Brookhaven National Lab., Upton, N.Y.
COHERENT BEHAVIOR IN JOSEPHSON JUNCTION ARRAYS
A. Saxena, J. E. Crow, and Myron Strongin [1973] 11 p refs Sponsored by AEC
(BNL-17232) Avail: NTIS

Experiments are described on a Josephson junction array, made by compressing small particles, which apparently show cooperative behavior. Samples were prepared by evaporating Al in a helium atmosphere, producing particles of about 100-to 500-A diameter. One observation is that of a steady zero-bias dc voltage across the sample when RF power is incident upon it. NSA

N73-21672# Brookhaven National Lab., Upton, N.Y.
SUPERCONDUCTING PROPERTIES OF CRYSTALLINE FILMS OF ALUMINUM ON SILICON
Myron Strongin, O. F. Kammerer, H. H. Farrell, and J. E. Crow [1973] 11 p refs Sponsored by AEC
(BNL-17240) Avail: NTIS

Superconductivity in well-ordered and well-characterized ultrathin epitaxial Al films on silicon was investigated. The transition temperature of the Al films is not very much higher than the bulk value, even down to thicknesses near 30 A. Films evaporated with more gas have higher critical temperatures and films oxidized by exposure to air also have increased critical temperatures. Although the higher resistance have broader transitions, the critical temperatures are the same. Results are shown and discussed. Author (NSA)

N73-21673# Cornell Univ., Ithaca, N.Y. Dept. of Materials Science and Engineering.
FLUX FLOW MEMORY SWITCH
A. G. Putz, M. Steingart, and E. J. Kramer [1973] 5 p refs Sponsored by AEC
(COO-3169-12; Rept-1784) Avail: NTIS

A memory switch, based on the multiple valued voltage-current characteristics of a plastically deformed type II superconductor, is described. Switching to the nonzero voltage state is accomplished with a current pulse sufficient to cause flux flow, which presumably disrupts the pin matching and/or perfection of the flux-line lattice (FLL). The minimum current pulse duration to cause this switching is approximately 100 microseconds at a peak electric field of 4 micron V/cm. Switching back to the zero voltage state is accomplished by sending a current pulse sufficient to heat the crystal above the critical temperature. In the experiments, heating was principally at a resistive spot weld in series with the crystal and in good thermal contact with it. Author (NSA)

N73-21674# Laboratoire Central de Recherches Thomson-CSF, Orsay (France).
[ELECTRONIC AND OPTOELECTRONIC MATERIALS] [MATERIAUX ELECTRONIQUES ET OPTOELECTRONIQUES]
Moulin, Merenda, and Faure 1 Dec. 1971 15 p In FRENCH
(Contract DGRST-70-7-2416)
Avail: NTIS HC $3.00

For the epitaxial growth from the liquid phase of binary and ternary systems, two technologies are presented: one horizontal with gradient, the other vertical and isothermal. For the binary 3-5 compounds GaAs and GaP, the following problems were solved: exact control of surface states; oxide removal from substrates; homogeneous thickness; and controlled doping during growth. The liquidus curve was determined for these compounds. For the ternary 4-6 compounds (PbSnSe, and PbSnTe), the growth conditions were deduced from the solid-liquid phase diagram. The problem of oxide removal from the substrate was not solved. The feasibility of heteroepitaxial growth of Pb, Sn, and Te on PbTe was demonstrated. ESRO

N73-21675# Maryland Univ., College Park. Dept. of Physics and Astronomy.
OPTICAL PROPERTIES AND THE ELECTRONIC STRUCTURE OF METAL ALLOYS Final Report
H. Dennis Drew Jan. 1973 13 p refs
(Grant AF-AFOSR-1932-70; AF Proj. 9763)
(AD-755847; AFOSR-72-2323TR) Avail: NTIS CSCL 20/12

New techniques were developed for making sensitive optical measurements on alloys over a wide range of the spectrum from the ultraviolet to the far infrared. Differences between samples with as little as 0.1 at.% impurity could be studied. The technique was used for optical studies of a number of noble metal-transition metal alloys. It was possible to make detailed quantitative comparisons between the optical data and the theory of dilute alloys. By comparisons between alloys which could be successfully described by the theory and those that could not, a systematic inadequacy of the theory was discovered. Author (GRA)

N73-21676# Illinois Univ., Urbana. Coordinated Science Lab.
HIGH BIAS STUDIES ON METAL-INSULATOR-METAL AND METAL-INSULATOR-SEMICONDUCTOR TUNNEL JUNCTIONS
Steven Wade Depp May 1972 126 p refs
(Contract DAAB07-67-C-0199)
(AD-755656; R-559; UILU-ENG-72-2220) Avail: NTIS CSCL 20/12

Tunnel junctions were fabricated on the grown-oxides of both cleaved single-crystal silicon and evaporated aluminum and have been studied over a wide bias range. At low biases the previously reported inelastic and self-energy structure is observed, while at intermediate biases tunneling into interface states is identified in p-type silicon junctions. At high biases both silicon and aluminum junctions display behavior which cannot be understood within the framework of the average potential barrier model: in particular, aluminum junctions with lead counterelectrodes show both anomalous structure and hysteresis in their I-V characteristics. To explain this behavior, a model is proposed in which (resonant) tunneling proceeds via the energy levels of mobile impurities in the barrier. Using this model, the hysteresis data are analyzed in detail in order to extract parameters describing the position and energy distribution of the impurities. These parameters obtained from the hysteresis data are found to simultaneously predict the anomalous I-V structure, indicating the common origin of both effects. Author (GRA)

N73-21677# Naval Research Lab., Washington, D.C.
LUMINESCENCE OF AgCl CRYSTALS
K. Vacek 23 Jan. 1973 15 p refs Transl. into ENGLISH from Cesk. Cas. Fys. (Czechoslovakia), v. B-10, 1960 p 66-73
(AD-755430; NRL-Trans-1262) Avail: NTIS CSCL 20/12

The luminescence of normal and deformed single crystals of AgCl of different thickness was measured at -180C. A decrease in luminescence intensity was found with the deformed samples. In the emission band of these samples, a fine structure was observed for which the series rule could be used. The observed luminescence was explained by means of the exciton mechanism proposed by Matyas, i.e., annihilation of a localized exciton, either on a cation vacancy or on the same vacancy on a dislocation jog. The luminescence yield was measured by a photographic method. Author (GRA)

N73-21678# Naval Research Lab., Washington, D.C. Electronics Div.
VAPOR PHASE EPITAXY OF GALLIUM ARSENIDE
Arrigo Addamiano 26 Jan. 1973 11 p refs
(AD-755434; NRL-7523) Avail: NTIS CSCL 20/2

GaAs epitaxial layers of good semiconductor quality (comparable to bulk GaAs) have been prepared by the arsine method. The preparative technique and improvements are described. Overall, the arsine system has proved not only reliable but simple as well. The growth rates are reasonably high for practical device fabrication. Author (GRA)

N73-21679# Naval Ordnance Lab., White Oak, Md.
BIBLIOGRAPHY ON SHOCK WAVES IN SOLIDS
D. L. Lethod 17 Nov. 1972 150 p refs
(AD-755429; NOLTR-72-274) Avail: NTIS CSCL 20/12

About 850 references are given to books, articles, and reports on theoretical and experimental aspects of shocks in solids. The topics include computer codes, composite media, and equations of state. Author (GRA)

N73-21680# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
DEFORMATION-MECHANISM MAPS AND THE CREEP OF TUNGSTEN LAMP FILAMENTS Interim Technical Report
H. J. Frost and M. F. Ashby Oct. 1972 38 p refs
(Contract N00014-67-A-0298-0020; NR Proj. 031-732)
(AD-755230; TR-7) Avail: NTIS CSCL 20/12

A crystalline solid can deform plastically in a number of ways. Deformation mechanism diagrams can be constructed which display the fields of stress and temperature in which a given mechanism is dominant, and the strain rate it yields. This report describes some refinements in the computation of the diagrams, and illustrates their use by means of a case-study: the creep of tungsten lamp filaments. Author (GRA)

N73-21681# City Coll. of the City of New York. Dept. of Electrical Engineering.
DYNAMIC INTERFACE EFFECTS Final Report, 1 Feb. 1969 - 30 Sep. 1972
Morris Ettenberg Jan. 1973 11 p refs
(Grant AF-AFOSR-1700-69; AF Proj. 9763)
(AD-755861; AFOSR-72-2404TR) Avail: NTIS CSCL 20/12

A detailed study was made of the electromagnetic response of magnetic semiconductors and composite magnetic and semiconducting structures in terms of the collective modes supported in these systems, which are mainly spin waves and carrier waves. These interactions have been studied in the linear regime and in the non-linear regime. The linear regime determines the small signal response of the systems while the non-linear regime is of interest in parametric effects. Measurements of the conductivity and magneto-resistance were made on single crystal Ag(x)Cd(1-x)Cr2Se4 (x = 0.045) for the case of an external constant magnetic field parallel to the conduction current. The measurements were made as a function of temperature, magnetic field strength, and electric field strength. The propagation characteristics of surface spin waves in YIG have been measured at microwave frequencies as a function of frequency and external magnetic field. Author (GRA)

N73-21682# Drexel Inst. of Tech., Philadelphia, Pa. Dept. of Chemistry.
ELECTRONIC SWITCHING PHENOMENA IN ORGANIC THIN FILMS
D. C. Larson and M. M. Labes (Temple Univ.) 30 Sep. 1972 20 p refs
(Contract DAHC04-70-C-0010; Grants
DA-ARO(D)-31-124-72-G13; DA-ARO(D)-31-124-71-G28; DA Proj. 200-61102-B-11B)
(AD-755267; AROD-8639-2-P) Avail: NTIS CSCL 20/12

The primary purpose of this program has been to investigate switching phenomenon in pure and doped organic films. The switching phenomena observed in organic films is quite different from that obtained with inorganic films and the mechanisms which have been developed to explain switching in inorganic films are in general not applicable to organic systems. For this reason a great deal of effort is spent in characterizing the films: isolating those factors such as film composition, thickness, and structure which control the observed phenomena. In addition the authors have investigated in some detail the electronic conduction processes in metal/organic film/metal sandwiches and these studies have contributed to the understanding of the switching phenomena. The results of the switching studies are briefly outlined. Author (GRA)

N73-21683# Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.
THE INFLUENCE OF ANNEALING ON THIN FILMS OF BETA SiC Physical Sciences Research Papers
Irvin Berman, Charles E. Ryan, Robert C. Marshall, and James R. Littler 19 Dec. 1972 19 p refs
(AF Proj. 5620)
(AD-755792; AFCRL-72-0737; AFCRL-PSRP-522) Avail: NTIS CSCL 20/2

Thin films of beta silicon carbide were prepared on alpha silicon carbide substrates by the chemical vapor deposition (CVD) technique involving the hydrogen reduction of silane and propane. The films were prepared under a variety of conditions and subsequently subjected to thermal annealing cycles between 1600C and 2000C. It is shown that the single crystallinity of the beta films improved with continued annealing. The beta polytype was found to be stable over the entire range of temperatures studied. Author (GRA)

N73-21684# Stanford Univ., Calif. Center for Materials Research.
SYNTHESIS OF COMPOUND SEMICONDUCTING MATERIALS AND DEVICE APPLICATIONS Semiannual Technical Report, 1 Jul. - 31 Dec. 1972
D. A. Stevenson 31 Dec. 1972 83 p
(Contract DAHC15-72-G-6; ARPA Order 1644-2)
(AD-755947; SU-CMR-73-2) Avail: NTIS CSCL 20/12

The present program concerns the synthesis of compound semiconducting materials, with particular emphasis on their use in new and novel microwave devices. The program is divided into three major sections: thin film epitaxial growth of III-V compounds; the design, fabrication and evaluation of microwave devices; and fundamental studies of crystal synthesis and properties. The devices of primary interest are of the planar microwave and acoustical type, employing thin films of GaAs as the active layer. Author (GRA)

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N73-21685*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SIMPLIFIED PROCEDURES FOR CORRELATION OF EXPERIMENTALLY MEASURED AND PREDICTED THRUST CHAMBER PERFORMANCE
W. B. Powell 1 Apr. 1973 94 p refs
(Contract NAS7-100)
(NASA-CR-131519; JPL-TM-33-548) Avail: NTIS HC $6.75 CSCL 21I

Thrust chamber performance is evaluated in terms of an analytical model incorporating all the loss processes that occur in a real rocket motor. The important loss processes in the real thrust chamber were identified, and a methodology and recommended procedure for predicting real thrust chamber vacuum specific impulse were developed. Simplified equations for the calculation of vacuum specific impulse are developed to relate the delivered performance (both vacuum specific impulse and characteristic velocity) to the ideal performance as degraded by the losses corresponding to a specified list of loss processes. These simplified equations enable the various performance loss components, and the corresponding efficiencies, to be quantified separately (except that interaction effects are arbitrarily assigned in the process). The loss and efficiency expressions presented can be used to evaluate experimentally measured thrust chamber performance, to direct development effort into the areas most likely to yield improvements in performance, and as a basis to predict performance of related thrust chamber configurations.
Author

N73-21686# Brigham Young Univ., Provo, Utah. Dept. of Chemical Engineering.
RESEARCH ON NONSTEADY COMBUSTION AND EXTINGUISHMENT Interim Report No. 2
Ralph L. Coates and M. Duane Horton May 1972 82 p refs
(Grant AF-AFOSR-1895-70; AF Proj. 9711)
(AD-755860; AFOSR-72-1182TR; IR-2) Avail: NTIS CSCL 21/9

Five different types of combustion experiments were carried out: conditioning temperature experiments; experiments to show the effects of external thermal radiation; measurements of steady flame temperature; experiments to determine the L^*-stability limit; and T-Burner experiments. Propellant samples from one particular lot of the Naval Weapons Center formulation A-13 were subjected to all five types of experiments. In addition, the three different formulations were subjected to the thermal radiation tests. An attempt was then made to correlate the experimental data with the predictions of a simplified theoretical model. The theoretical model was found to satisfactorily correlate the effects of variations

in conditioning temperature and thermal radiation using a value for the gas phase activation energy, Eg, of 45 Kcal/mole, provided that the variation of the flame-temperature with pressure was adequately accounted for. Author (GRA)

N73-21687# Rocketdyne, Canoga Park, Calif.
PROPELLANT SPRAY COMBUSTION PROCESSES Final Report, Nov. 1970 - Nov. 1972
R. D. Sutton Jan. 1973 62 p refs
(Contract F44620-71-C-0003; AF Proj. 9711)
(AD-755879; R-9135; AFOSR-73-0221TR) Avail: NTIS CSCL 21/9

The purpose of this program was to define, through analysis and experiment, the mechanisms of energy addition from propellant-spray combustion to steady-flow fields and propagating pressure disturbances. Such information is important because it forms the basis of steady-state and transient propellant combustion models to accurately predict performance and combustion instability characteristics in liquid-propellant rocket and air-breathing engines and, thus, minimize the probability of encountering problems with these factors during engine development. A specialized model rocket engine was constructed to permit detailed observation of the spray-combustion processes occurring under well-defined conditions. The apparatus was designed to produce a monodisperse propellant spray uniformly distributed throughout the combustor. The motor could be operated under either stable or transient conditions and contained quartz windows on two sides to permit optical observation of the vaporizing droplets. Author (GRA)

N73-21688# Air Force Aero Propulsion Lab., Wright-Patterson AFB, Ohio.
PRELIMINARY INVESTIGATION OF FUEL TANK ULLAGE REACTIONS DURING HORIZONTAL GUNFIRE Final Technical Report, 1 Dec. 1970 - 30 Jun. 1972
R. G. Clodfelter and E. E. Ott Nov. 1972 72 p
(AF Proj. 3048)
(AD-755361; AFAPL-TR-72-55) Avail: NTIS CSCL 21/4

The report deals with the effect horizontal gunfire has on the flammability of hydrocarbon turbine fuel in aircraft fuel tanks. Two fuels, JP-4 and JP-8, were used in the testing. The fuels were placed in an explosion-proof test vessel and subjected to CAL .50 (Armor-Piercing Incendiary) gunfire. A wide range of conditions were investigated and the results are presented. The test program was designed to briefly explore the many facets of the fuel tank fire and explosion problem with the intent of investigating in more detail during future testing those areas which appear to be of major significance. Author (GRA)

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magneto-hydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N73-21689 Georgia Inst. of Tech., Atlanta.
A THEORETICAL STUDY OF NONLINEAR LONGITUDINAL COMBUSTION INSTABILITY IN LIQUID PROPELLANT ROCKET ENGINES Ph.D. Thesis
Manuel Edward Lores 1972 212 p
Avail: Univ. Microfilms Order No. 72-20604

Nonlinear analyses of the stability of moderate and large amplitude high frequency longitudinal combustion-driven oscillations in liquid propellant rocket motors are presented. The objective of these investigations is to provide rocket design engineers with straightforward analytical techniques for the nonlinear analysis of longitudinal combustion instability. The resulting methodology (1) provides physical insight into the phenomenon of longitudinal combustion instability, (2) clarifies certain ambiguities in previous investigations of the problem, and (3) requires a minimum of mathematical computations. It is believed that the techniques developed can also be used to investigate axial mode combustion instability problems in solid propellant rocket motors and air-breathing propulsion devices. Dissert. Abstr.

N73-21690*# Lockheed Missiles and Space Co., Huntsville, Ala. Research and Engineering Center.
EVALUATION OF A 40 TO 1 SCALE MODEL OF A LOW PRESSURE ENGINE
Charles E. Cooper and Juergen Thoenes 31 Dec. 1972 106 p refs
(Contract NAS8-28899)
(NASA-CR-124176; HREC-8899-2; LMSC/HREC-D306359) Avail: NTIS HC $7.50 CSCL 21H

An evaluation of a scale model of a low pressure rocket engine which is used for secondary injection studies was conducted. Specific objectives of the evaluation were to: (1) assess the test conditions required for full scale simulations; (2) recommend fluids to be used for both primary and secondary flows; and (3) recommend possible modifications to be made to the scale model and its test facility to achieve the highest possible degree of simulation. A discussion of the theoretical and empirical scaling laws which must be observed to apply scale model test data to full scale systems is included. A technique by which the side forces due to secondary injection can be analytically estimated is presented. Author

N73-21691*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF INLET-AIR HUMIDITY ON THE FORMATION OF OXIDES OF NITROGEN IN A GAS-TURBINE COMBUSTOR
Nicholas R. Marchionna Mar. 1973 25 p refs
(NASA-TM-X-68209; E-7391) Avail: NTIS HC $3.25 CSCL 21E

Tests were conducted to determine the effect of inlet-air humidity on the formation of oxides of nitrogen from a gas-turbine combustor. Combustor inlet-air temperature ranged from 450 F to 1050 F. The tests were run at a constant pressure of 6 atmospheres and reference Mach number of 0.065. The NO sub x emission index was found to decrease with increasing inlet-air humidity at a constant exponential rate of 19 percent per mass percent water vapor in the air. This decrease of NO sub x emission index with increasing humidity was found to be independent of inlet-air temperature. Author

N73-21692*# Naval Air Propulsion Test Center, Trenton, N.J.
ROTOR BURST PROTECTION PROGRAM: STATISTICS ON AIRCRAFT GAS TURBINE ENGINE FAILURES THAT OCCURRED IN COMMERCIAL AVIATION DURING 1971
R. A. Delucia and G. J. Mangano Feb. 1973 11 p Sponsored by NASA
(NASA-CR-131525; NAPTC-PE-12) Avail: NTIS HC $3.00 CSCL 21E

A program to develop criteria for the design of devices that will be used on aircraft to protect passengers and the aircraft structure from the lethal and devastating fragments generated by the disintegration of a gas turbine engine rotor is discussed. Statistics on gas rotor turbine failures that have occurred in commercial aviation in 1971 are presented. It is shown that 124 rotor failures occurred and 35 of these were uncontained. This figure is considered significantly high to justify continuation of the development program. Author

N73-21693*# LTV Aerospace Corp., Dallas, Tex. Vought Systems Div.
ANALYSIS OF INLET FLOW DISTORTION AND TURBULENCE EFFECTS ON COMPRESSOR STABILITY
H. C. Melick 31 Mar. 1973 225 p refs
(Contract NAS2-6901)
(NASA-CR-114577; TR-2-57110/3R-3071) Avail: NTIS HC $13.25 CSCL 21E

The effect of steady state circumferential total pressure distortion on the loss in compressor stall pressure ratio has been established by analytical techniques. Full scale engine and compressor/fan component test data were used to provide direct evaluation of the analysis. Specifically, since a circumferential total pressure distortion in an inlet system will result in unsteady flow in the coordinate system of the rotor blades, analysis of this type distortion must be performed from an unsteady

aerodynamic point of view. By application of the fundamental aerothermodynamic laws to the inlet/compressor system, parameters important in the design of such a system for compatible operation have been identified. A time constant, directly related to the compressor rotor chord, was found to be significant, indicating compressor sensitivity to circumferential distortion is directly dependent on the rotor chord. Author

N73-21694*# Scientific Translation Service, Santa Barbara, Calif.
SPECIFIC IMPULSE OF MINIATURE MOTORS EMPLOYING CRYOGENIC FUELS
P. V. Semenikhin Washington NASA 16 Apr. 1973 10 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Aviats. Tekhn. (Kazan), v. 14, no. 3, 1971 p 50-53
(Contract NASw-2483)
(NASA-TT-F-14878) Avail: NTIS HC $3.00 CSCL 21H

Auxiliary rocket thrusters in which large mass savings are achieved by using liquefied gases as the propellant are examined. A method of evaluating the mass characteristics of such systems is proposed, along with methods of evaluating propellant efficiency. Estimates of the specific impulse obtainable with various propellants are obtained. Author

N73-21695*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AN ADVERSE EFFECT OF FILM COOLING ON THE SUCTION SURFACE OF A TURBINE VANE
Herbert J. Gladden, James W. Gauntner, Frederick C. Yeh, and Daniel J. Gauntner [1973] 8 p refs
(NASA-TM-X-68210; E-7392) Avail: NTIS HC $3.00 CSCL 21E

A J-75 size turbine vane with film cooling holes on the suction surface near the leading edge was tested with and without film cooling flow in a four-vane cascade. Results show that the cooling effectiveness on the aft portion of the vane suction surface can decrease with the addition of film cooling near the leading edge. Apparently the film cooling air flow caused a laminar or transitional boundary layer to become a transitional or turbulent boundary layer. The vane was tested at a gas temperature and pressure of 1260 K (1800 F) and 22.7 newtons per square centimeter (33 psia), a coolant temperature of 280 K (50 F), film cooling flow ratios from 0.0 to 0.026, and backside midchord cooling flow ratios of 0.007 and 0.035. Author

N73-21696# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Abteilung Elektrische Antriebe.
DESIGN AND MECHANISM OF AN AUTOCATHODE [AUFBAU UND FUNKTION EINER AUTOKATHODE]
Harro Bessling Sep. 1972 42 p refs In GERMAN; ENGLISH summary
(DLR-FB-72-73) Avail: NTIS HC $4.25; DFVLR, Porz, West Ger. 11,50 DM

The design of a test device for an autocathode is described and a theoretical investigation of the autocathode mechanism is given. The autocathode is located in the center of a discharge chamber with a cylindrical anode in a 100 l-vacuum tank. The ignition of the autocathode requires special means, which are also explained. The electron emission mechanism of this cathode was found as a field emission. Finally the electrical field, the electron and ion current density, and the neutral particle flux in the cathode volume were calculated for a presupposed discharge current. Performance data are presented in tables and in diagrams. Author (ESRO)

N73-21697# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ENGINES OF SOLID FUEL ROCKETS
V. V. Rozhkov 4 Jan. 1973 145 p refs Transl. into ENGLISH from the monograph "Dvigateli Raket na Tverdom Toplive" Moscow, 1971 p 1-118
(AD-755411; FTD-MT-24-1454-72) Avail: NTIS CSCL 21/8

In the report the arrangement of contemporary solid-propellant rocket engines, their elements and units are discussed and the characteristics and classification of engines are given. Layout diagrams of rockets with solid-propellant rocket engines are examined and the basic methods of heat shielding of engines and the possible layouts for control of thrust in magnitude and direction are set forth. The future of the development of solid-propellant engines is pointed out. The pamphlet does not deal with solid propellants and their characteristics, with which the reader will become acquainted in a special publication of the current series. Author (GRA)

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics, and 24 Physics, Atomic, Molecular, and Nuclear.

N73-21698 New Hampshire Univ., Durham.
OBSERVATION OF PULSED GAMMA RAYS WITH ENERGIES GREATER THAN 250 keV FROM THE CRAB NEBULA PULSAR NP 0532 Ph.D. Thesis
Larry Eugene Orwig 1972 231 p
Avail: Univ. Microfilms Order No. 72-19028

Data from a balloon flight experiment using a NaI scintillation spectrometer were analyzed to search for gamma ray pulsations from the pulsar NP 0532. The flight was conducted on June 7, 1970, and the payload was carried to a nominal atmospheric depth of 3.5 g/sq cm. The detector was pointing in the direction of the Crab Nebula for the entire time at float altitude. A superposed epoch analysis was performed on a 12,000 second portion of the data spanning a total time interval of 16,700 seconds at float altitude. A positive pulsed contribution was observed at the expected apparent frequency of NP 0532 having the double pulse structure typical of NP 0532. A further subdivison of the energy interval was performed to obtain spectral information above 250 keV. Above 725 keV no pulsed contribution was found. Therefore, upper limits at the 95% confidence level were obtained for two energy bins, one extending from 725 keV to 2.3 MeV, and the second an integral channel above 2.3 MeV. No evidence was found for an enhancement in the pulsed flux at the 0.5 MeV annihilation line region. Dissert. Abstr.

N73-21699 Stanford Univ., Calif.
THE STRUCTURE AND HEATING OF THE CHROMOSPHERE-CORONA TRANSITION REGION Ph.D. Thesis
Ronald Lee Moore 1972 141 p
Avail: Univ. Microfilms Order No. 72-20718

The structure and heating (or energy balance) of the transition region and the role of the transition region in the structure and heating of the atmosphere as a whole are examined. The problem is defined by summarizing the well-established observed features of the structure of the atmosphere and by reviewing the observed radiative energy losses of the atmosphere. After obtaining an overall picture of the structure and heating of the atmosphere as a whole, a static, planar model of the transition region is developed which is heated by thermal conduction from the corona and cooled by radiative losses. From the good agreement between the model and the results of XUV emission line observations of the transition region it is found that the transition region is heated primarily by thermal conduction from the corona rather than by wave dissipation, and the balance of conduction heating and radiative cooling in the transition region determines the number density in the transition region and lower corona.
Dissert. Abstr.

N73-21700# Michigan Univ., Ann Arbor. High Altitude Engineering Lab.
SATELLITE MEASUREMENT OF STRATOSPHERIC POLLUTANTS AND MINOR CONSTITUENTS BY SOLAR OCCULTATION: A PRELIMINARY REPORT Final Report
S. R. Drayson, F. L. Bartman, W. R. Kuhn, and R. Tallamraju Nov. 1972 149 p refs
(Grant NOAA-NG-10-72; ORA Proj. 011023)
(Rept-011023-1-T) Avail: NTIS HC $9.50

The feasibility of determining concentrations of pollutants and minor constituents from satellite measurement of solar occultation absorption in the infrared is examined. The molecules considered include water vapor, O3, OH, CO2, CO, CH4, N2O, NO, NO2, N2O5, HNO3, and also aerosols. A survey of experimentally and theoretically determined concentrations and

of infrared spectral properties is made for each constituent. Atmospheric applications and estimates of stratospheric absorption are included. Author

N73-21701*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THE ATTENUATION OF X-RAYS EMITTED BY SUPERNOVAE
Klaus Schocken Mar. 1973 12 p refs
(NASA-TM-X-64722) Avail: NTIS HC $3.00 CSCL 03B

The attenuation of X-rays in Arnett's C-12 detonation supernova model is computed. The attenuation of X-rays in the filaments of the Crab Nebula is computed using a model for the filaments by Woltjer and a model by Davidson and Tucker. An empirical expression by Gorenstein, Kellogg, and Gursky for the optical thickness of the interstellar medium for three supernova remnants is analyzed. Author

N73-21702*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE RADIATION BALANCE OF THE EARTH-ATMOSPHERE SYSTEM FROM NIMBUS 3 RADIATION MEASUREMENTS
Ehrhard Raschke, Thomas H. VonderHaar, Musta Pasternak, and William R. Bandeen Washington Apr. 1973 76 p refs
(NASA-TN-D-7249; G-1086) Avail: NTIS HC $3.00 CSCL 03B

The radiation balance of the earth-atmosphere system and its components was computed from global measurements of radiation reflected and emitted from the earth to space. These measurements were made from the meteorological satellite Nimbus 3 during the periods from April 16 to August 15, 1969; October 3 to 17, 1969; and January 21 to February 3, 1970. Primarily the method of evaluation, its inherent assumptions, and possible error sources were discussed. Results are presented by various methods: (1) global, hemispherical, and zonal averages obtained from measurements in all semimonthly periods and (2) global maps of the absorbed solar radiation, the albedo, the outgoing longwave radiation, and the radiation balance obtained from measurements during semimonthly periods in each season (May 1 to 15, July 16 to 31, and October 3 to 17, 1969, and January 21 to February 3, 1970). Annual global averages of the albedo and of the outgoing longwave radiation were determined. These values balance to within 1 percent the annual global energy input by solar radiation that was computed for a solar constant. Author

N73-21703# California Univ., Los Angeles. Plasma Physics Group.
ON COSMIC RAY GENERATION BY PULSARS
C. F. Kennel, G. Schmidt, and T. Wilcox Apr. 1973 16 p refs Sponsored by ONR and NSF
(PPG-144) Avail: NTIS HC $3.00

The generation of cosmic rays by the acceleration of charged particles caused by the electromagnetic fields of pulsars is proposed. A self-consistent solution of an electromagnetic wave propagating in a plasma was conducted. It was determined that the electromagnetic wave can drive electrons and ions in the direction of wave propagation. This fact and symmetry in particle motion perpendicular to the propagation direction for oppositely charged particles lead to the approximate absence of parallel electric fields and a simple dispersion relation. This relation sets an upper limit to the particle flux that can be injected into the wave. Energy transport is equally divided between electromagnetic and particle energy fluxes. The consequences to cosmic generation in pulsars are outlined. Author

N73-21704*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PROPAGATION PATTERN OF INTERPLANETARY SHOCK WAVES ASSOCIATED WITH SOLAR PROTON FLARES
Kunitomo Sakurai (Maryland Univ.) Apr. 1973 24 p refs
(NASA-TM-X-66226; X-693-73-90) Avail: NTIS HC $3.25 CSCL 03B

The two-dimensional pattern of interplanetary shock waves is deduced by taking into account the solar longitude dependence of the time intervals between SSC geomagnetic storms and responsible flares. This pattern near the earth's orbit is not symmetric with respect to the meridian plane which crosses the position of the flare, and the highest speed of this wave propagation is observed in the direction about 30 degrees east of this meridian plane. The magnitude of the Forbush decreases of galactic cosmic rays also varies with the longitude positions of those flares. This is used to estimate the distribution of magnetic fields behind the shock waves. Author

N73-21705*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ON THE INTERPLANETARY SHOCK WAVES ASSOCIATED WITH SOLAR FLARES IN THE ACTIVE REGION McMATH NO. 9740
Kunitomo Sakurai Apr. 1973 15 p refs
(NASA-TM-X-66227; X-693-73-97) Avail: NTIS HC $3.00 CSCL 03B

The propagation pattern of shock waves emitted by solar flares which occured in the active region McMath No. 9740 during 23 October to 4 November 1968 is discussed. The solar flares were associated with type 2 and 4 radio bursts and with SSC geomagnetic storms. The flares and associated phenomena are summarized and the transmit times between the sun and the earth of the shock waves associated with the flares are shown. It is concluded that the interplanetary magnetic field controls the propagation of shock waves emitted by solar flares. It was also determined that the large scale configuration of the interplanetary magnetic field was not disturbed by the successive propagation of the shock waves. Author

N73-21706*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
VARIATIONS OF THE RELATIVE ABUNDANCES OF He, (C,N,O) AND Fe-GROUP NUCLEI IN SOLAR COSMIC RAYS AND THEIR RELATIONSHIP TO SOLAR PARTICLE ACCELERATION
D. L. Bertsch, S. Biswas, C. E. Fichtel, C. J. Pellerin, and D. V. Reames Apr. 1973 23 p refs Submitted for publication
(NASA-TM-X-66228; X-662-73-98) Avail: NTIS HC $3.25 CSCL 03B

Measurements of the flux of helium nuclei in the 24 January 1971 event and of helium and (C,N,O) nuclei in the 1 September 1971 event are combined with previous measurements to obtain the relative abundances of helium, (C,N,O), and Fe-group nuclei in these events. These data are then summarized together with previously reported results to show that, even when the same detector system using a dE/dx plus range technique is used, differences in the He/(C,N,O) value in the same energy/nucleon interval are observed in solar cosmic ray events. Further, when the He/(C,N,O) value is lower the He/(Fe-group nuclei) value is also systematically lower in these large events. When solar particle acceleration theory is analyzed, it is seen that the results suggest that, for large events, Coulomb energy loss probably does not play a major role in determining solar particle composition at higher energies (>10 MeV). The variations in multicharged nuclei composition are more likely due to partial ionization during the acceleration phase. Author

N73-21707# Brookhaven National Lab., Upton, N.Y.
REPORT ON THE BROOKHAVEN SOLAR NEUTRINO EXPERIMENT
R. Davis, Jr., J. C. Evans, V. Radeka, and L. C. Rogers [1972] 17 p refs Presented at Symp. on Neutrino '72, Balatonfured, Hungary, 11 Jun. 1972 Sponsored by AEC
(BNL-16937; Conf-720651-1) Avail: NTIS

The radioactive Ar-37 (35.1-day half-life) is removed from the liquid by purging with helium gas, purified, and counted in a small low-level proportional counter. Argon-37 decay events are characterized by the energy of the event, and the rise time of the counter pulse. The results of six experiments are given. The Ar-37 production rate in the detector was 0.18 + or - 0.10 per day, close to the production rate expected from cosmic ray muons. Author (NSA)

N73-21708# California Univ., Berkeley. Dept. of Physics.
ASTROPHYSICAL AND SUPERHEAVY ELEMENT STUDIES WITH NUCLEAR TRACK IN SOLIDS Progress Report, 1 Sep. 1971 - 31 Aug. 1972
P. B. Price 13 Aug. 1972 6 p refs
(Contract AT(04-3)-34)

(UCB-34-P-189-X-3) Avail: NTIS

Work is reported in the following areas: nuclear reactions with relativistic heavy ions at the bevatron, high-Z cosmic rays, heavy particles emitted in solar flares, particle-identification techniques, and theoretical astrophysics. NSA

N73-21709# Imperial Coll. of Science and Technology, London (England). Dept. of Physics.
THE UNPRECEDENTED COSMIC RAY DISTRUBANCES OF EARLY AUGUST 1972
J. C. Dutt, J. E. Humble, and T. Thambyahpillat [1972] 16 p refs
Avail: NTIS HC $3.00

A preliminary account is given of the severe and complex cosmic ray disturbances which were observed during the period 3 to 8 August 1972, following the occurrence of intense solar flares erupting chiefly in the McMath plage region 11976. The cosmic ray disturbances include two solar proton events which were energetic enough to be recorded by ground-level neutron monitors but were otherwise unspectacular and at least three Forbush decreases of which the first and third did not exhibit any extraordinary properties. The second Forbush event was characterised not only by an exceptionally large amplitude but also by an extremely short onset phase so that the rate of depletion of intensity was the highest ever recorded since neutron monitor observations commenced. Also, the recovery rate was much more rapid than average. As many of the characteristics of these events that can be deduced from the meagre data at hand are detailed. Author (ESRO)

N73-21710# Max-Planck-Institut fuer Physik und Astrophysik, Munich (West Germany). Inst. fuer Extraterrestrische Physik.
STUDIES OF INTERSTELLAR GAS HEATING BY COSMIC RADIATION [UNTERSUCHUNGEN ZUR AUFHEIZUNG DES INTERSTELLAREN GASES DURCH KOSMISCHE STRAHLUNG]
Heiner Billing May 1972 135 p refs In GERMAN
(MPI-PAE/Extraterr-72) Avail: NTIS HC $8.75

The effects of increased cosmic ray flux, such as near former supernovae, on the temperature and ionization rate of the local interstellar gas were investigated. Two conditions were set out: thermal radiation was taken into account since temperatures of over 10,000 K may be reached; greater accuracy should be applied in describing the interaction of cosmic rays and free electrons. The equilibria for temperature and ionization were numerically calculated from the gain and loss rates. A more accurate analysis of the relations showed that even after the commencement of thermal ionization, temperature and ionization rate are determined by the cosmic ray flux normalized with respect to the hydrogen density. The results are applied in determining the dispersion rate of pulsars. ESRO

N73-21711# Boston Coll., Chestnut Hill, Mass. Dept. of Physics.
REVIEW OF SOLAR FLARE PHENOMENA
Pradip M. Bakshi and Gabor Kalman Apr. 1972 55 p refs
(Contract F19628-71-C-0078; AF Proj. 8659)
(AD-755913; Scientific-2; AFCRL-72-0282) Avail: NTIS CSCL 03/2

A review of the present picture concerning the solar flare event is presented. Optical, radio, X-ray and particle spectra, their time-dependence and interrelations are discussed. A compilation of the chronology of the flare event is given. A flare model based on the recent work of Coppi and Friedland is analyzed with representative numerical data. The problem of the acceleration of protons to the very high energies observed is discussed and suggestions for new accelerating mechanisms resulting from strong plasma turbulence processes are put forward. Author (GRA)

N73-21712# Army Foreign Science and Technology Center, Charlottesville, Va.
FILM SOLAR ENERGY COLLECTOR WITH CONCENTRIC CIRCULAR SEAMS
A. Kh. Kamildzhanov 15 Jan. 1973 12 p refs Transl. into ENGLISH from Geliotekh. (USSR), no. 1, 1970
(AD-755829; FSTC-HT-23-1208-72) Avail: NTIS CSCL 13/1

At the present time, plastic films, covered on one side with a thin layer of aluminum, are used as solar energy concentrators in heliotechnology. Commercially produced film is insufficiently broad to obtain concentrators with large concavities. Therefore, in making concentrators with diameters larger than the film width, their surfaces are glued together from pieces. Thus, concentrators with parallel, radial and circular concentric seams are discussed. The results of experimental investigations of such concentrators was compared with data from investigations of concentrators without seams. Mirror diameters were identical, 0.5m in all variants of the tests, and the width and number of seams were not indicated. Author (GRA)

N73-21746* Bern Univ. (Switzerland). Physikalisches Inst.
SOLAR WIND COMPOSITION EXPERIMENT
J. Geiss, F. Buehler, H. Cerutti, P. Eberhardt, and Ch. Filleux *In* NASA. Lyndon B. Johnson Space Center Apollo 16 Prelim. Sci. Rept. 1972 10 p refs (For availability see N73-21729 12-30)
CSCL 03C

N73-21747* General Electric Co., Philadelphia, Pa.
COSMIC RAY EXPERIMENT. PART A: COMPOSITION AND ENERGY SPECTRA OF SOLAR COSMIC RAY NUCLEI
R. L. Fleischer and H. R. Hart, Jr. *In* NASA. Lyndon B. Johnson Space Center Apollo 16 Prelim. Sci. Rept. 1972 9 p (For availability see N73-21729 12-30)
CSCL 03C

N73-21748* California Univ., Berkeley.
COMPOSITION OF INTERPLANETARY PARTICLES AT ENERGIES FROM 0.1 TO 150 MeV/NUCLEON, PART B
P. B. Price, D. Braddy, D. OSullivan, and J. D. Sullivan *In* NASA. Lyndon B. Johnson Space Center Apollo 16 Prelim. Sci. Rept. 1972 8 p (For availability see N73-21729 12-30)
CSCL 03C

N73-21749* California Inst. of Tech., Pasadena.
SOLAR COSMIC RAY, SOLAR WIND, SOLAR FLARE, AND NEUTRON ALBEDO MEASUREMENTS, PART C
D. Burnett, C. Hohenberg (Washington Univ., St. Louis), M. Maurette (CNRS, Orsay, France), M. Monnin (Clermont-Ferrand Univ.), R. Walker, and D. Wollum *In* NASA. Lyndon B. Johnson Space Center Apollo 16 Prelim. Sci. Rept. 1972 14 p refs (For availability see N73-21729 12-30)
CSCL 03C

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N73-21713 Oregon State Univ., Corvallis.
ELEMENTAL ABUNDANCES IN METEORITIC CHONDRULES Ph.D. Thesis
Thomas Ward Osborn, III 1972 368 p
Avail: Univ. Microfilms Order No. 72-9820

High-precision instrumental neutron activation analysis has been used to determine Al, Na, Mn, Sc, Cr, Fe, Co, and Ni in a suite of more than 500 chondrules from 26 distinct meteorites. These meteorite specimens represent the H, L, LL and C chemical classes and most of the petrologic types. In addition radiochemical activation analysis has been used to determine K, Rb and Cs in a suite of chondrules from the LL chemical class. To a limited extent trace element data on individual chondrules were correlated with petrographic observations on the same chondrules.
Dissert. Abstr.

N73-21714 Lunar Science Inst., Houston, Tex.
POST-APOLLO LUNAR SCIENCE
Jul. 1972 111 p refs
(LC-72-93379) Copyright. Avail: Issuing Activity

The post-Apollo period is discussed in terms of future lunar scientific investigations to supplement the Apollo accomplishments. Among the specific objectives recommended are: broader

landing capabilities than Apollo; improved horizontal and vertical mobility (unmanned and manned rovers and flyers); more reliable methods of surface navigation; sampling and documentation (including deep drilling); and active geochemical and geophysical sensing. It is concluded that these types of studies will produce the elementary data necessary for a foundation in future planetary exploration. J.M.M.

N73-21715 California Univ., Los Angeles.
PLANETARY THEORY WITH RECURSIVE LINEARIZATION Ph.D. Thesis
Michael Savage West Keesey 1972 191 p
Avail: Univ. Microfilms Order No. 72-20450

A computerized series manipulation system is applied to the development of a planetary theory based upon power series expansions of the rectangular components in the masses of the perturbing planets. The perturbation terms of these expansions are obtained by linearizing the perturbed two-body equations of motion and solving the resulting linear equations in a recursive manner. The linear inhomogeneous differential equations are all of the same form but with different force functions. This has permitted the series manipulation program to be constructed in a standard format with the series expressions for the force functions being generated in external interchangeable subroutines. Dissert. Abstr.

N73-21716 California Univ., Los Angeles.
Pc 5 GEOMAGNETIC MICROPULSATIONS OBSERVED AT THE SYNCHRONOUS EQUATORIAL SATELLITE ATS-1 DURING MAGNETIC STORMS Ph.D. Thesis
Joseph Neil Barfield 1972 199 p
Avail: Univ. Microfilms Order No. 72-20418

The results of a study of the characteristics of Pc 5 geomagnetic micropulsations observed at the synchronous, equatorial satellite ATS 1 are presented. Magnetic field data from the UCLA fluxgate magnetometer on board ATS 1 formed the basis for the study. The results show that the stormtime Pc 5 micropulsations play an important role in the dynamics of the stormtime ring current, and in the processes reponsible for the magnetospheric substorm. A study of the stormtime Pc 5's observed at ATS 1 during 1967 clearly established that the micropulsations are associated with the main phase minimum of geomagnetic storms, and are confined to the afternoon sector. The observed Pc 5's had a mean frequency of 0.005 Hz and a mean amplitude of 10 gammas; a typical event lasted one hour. Dissert. Abstr.

N73-21717 California Univ., Los Angeles.
SOME SPECIAL PERTURBATION METHODS FOR THE INTEGRATION OF ARTIFICIAL SATELLITE ORBITS Ph.D. Thesis
Paul Wong 1972 124 p
Avail: Univ. Microfilms Order No. 72-20485

The use of non-Keplerian reference orbits and step size uniformizing variables as means of improving computational efficiency in the numerical integration of near earth satellite orbits is investigated. The Garfinkel intermediary orbit and Hori's 1st order solution of the satellite problem are employed in Encke-type integration schemes, to incorporate the principal oblateness perturbation in the reference orbit in the Encke method. The Garfinkel orbit is also used to illustrate a variation of parameters method based on the separation constants in the solution of the Hamilton-Jacobi equation. A step size uniformizing transformation is used to transform the equations of motion in a Cowell integration. Computer simulations are performed to determine the relative efficiency of the various methods taking into consideration orbit eccentricity, computation load in the derivative evaluation, and order of the numerical integrator. Dissert. Abstr.

N73-21718 George Washington Univ., Washington, D.C.
AN EMPIRICAL METHOD FOR DETERMINING THE LUNAR GRAVITY FIELD Ph.D. Thesis
Alfred John Ferrari 1972 159 p
Avail: Univ. Microfilms Order No. 72-19026

A new method was devised to determine the spherical harmonic coefficients of the lunar gravity field. This method consists of a two-step data reduction and estimation process. In the first step, a weighted least-squares empirical orbit determination scheme is applied to Doppler tracking data from lunar orbits to estimate long-period Kepler elements and rates. Each of the Kepler elements is represented by an independent function of time. The long-period perturbing effects of the earth, sun, and solar radiation are explicitly modeled in this scheme. Kepler element variations estimated by this empirical processor are ascribed to the non-central lunar gravition features. Doppler data are reduced in this manner for as many orbits as are available. In the second step, the Kepler element rates are used as input to a second least-squares processor that estimates lunar gravity coefficients using the long-period Lagrange perturbation equations. Dissert. Abstr.

N73-21719 Illinois Univ., Urbana.
WHITE DWARFS AND NEUTRON STARS Ph.D. Thesis
Peter Gordon Sutherland 1972 148 p
Avail: Univ. Microfilms Order No. 72-19943

The equation of state of zero-temperature matter in complete nuclear equilibrium is given for mass densities below 5 x 10 to the 14th power g/cu cm. Redetermination is made, taking into account the effect of the Coulomb lattice and using more recent nuclear mass extrapolations, of the sequence of equilibrium nuclides present at mass densities between 10 to the 4th power g/cu cm and 4.3 x 10 to the 11th power g/cu cm, the point of neutron drip. For densities between 4.3 x 10 to the 11th power g/cu cm and 5 x 10 to the 14th power g/cu cm the equation of state is taken from the calculations of Baym, Bethe and Pethick; included are extensions of the equation of state to still higher densities, taken from the calculations of Pandharipande, which include the effects of hyperons. Calculation of the equation of state is made for zero-temperature white dwarf and neutron star models. In addition, moments of inertia, surface deformations, and mass quadrupole moments are calculated for slowly rotating neutron stars. Dissert. Abstr.

N73-21720 Maryland Univ., College Park.
A STUDY OF NEUTRAL HYDROGEN GAS MOTION WITHIN SPIRAL ARMS AND IN THE LOCAL REGION Ph.D. Thesis
Ronald Harold Harten 1972 132 p
Avail: Univ. Microfilms Order No. 72-20492

Data from several recent high resolution 21 cm line studies were analysed in a two-part study of the motions of the neutral hydrogen gas within spiral arm features perpendicular to the galactic plane. In any given feature the velocity gradient appears to vary smoothly over a large extent in longitude, indicating that the cause must be a large scale effect. The observed gradient curves of the different spiral features can generally be explained in terms of a combination of simple toroidal tumbling and shear motions. The variation of the parameters in the Lin density wave theory as a function of distance from the galactic plane was examined. There appears also to be a strong correlation between the local magnetic field structure proposed by Mathewson and the velocity distribution of the local component. Dissert. Abstr.

N73-21721 Illinois Univ., Urbana.
POLARIZATION APERTURE SYNTHESIS OF FIVE GALACTIC NONTHERMAL RADIO SOURCES Ph.D. Thesis
Bruce Raymond Hermann 1972 329 p
Avail: Univ. Microfilms Order No. 72-19846

Five possible supernova remnants are mapped using the techniques of aperture synthesis interferometry. The objects 3C 10 (Tycho's supernova), 3C 58, DR 4 (the Gamma-Cygni radio source), 4C28.16 (located in the shell of S-147), and 3C358 (Kepler's supernova) were mapped at 11.1 cm. wavelength with a three-element interferometer. Intensity maps, polarization intensity maps, and electric vector position angle maps were obtained. A special polarization calibration scheme for this instrument was developed which employs both the tensor approach of Ko and the empirical correction procedure of Conway and Kronberg. Dissert. Abstr.

N73-21722 Stanford Univ., Calif.
ATTITUDE MOTIONS OF A HALO SATELLITE DUE TO SOLAR PRESSURE AND GRAVITY GRADIENT Ph.D. Thesis
James Vincent Carroll 1972 169 p
Avail: Univ. Microfilms Order No. 72-16701

The use of satellites operating in the far moon side libration point for space communications in support of lunar missions

is discussed. The attitude control of the satellite using the environmental forces of gravity gradient and solar radiation pressure is analyzed. Solar pressure attitude equations are developed for bodies with nearly spherical surface. A transformation theory is used which allows the solar torque to be described in terms of spherical harmonic coefficients defined in the control frame, rather than in a sun-fixed frame. Several solar torque control configurations are postulated and analyzed.
Dissert. Abstr.

N73-21723 Maryland Univ., College Park.
HIGH FREQUENCY RESOLUTION HI LINE OBSERVATIONS OF INTERSTELLAR DUST CLOUDS Ph.D. Thesis
Gillian Revill Knapp 1972 263 p
Avail: Univ. Microfilms Order No. 72-20253

The density and temperature of atomic hydrogen in dense interstellar dust clouds was investigated by searching for narrow self-absorption dips in the 21-cm emission profiles in the directions of such clouds. It was found that about half of the dust clouds observed showed self-absorption dips and that the greater the observed optical density of the clouds the greater the chance of their showing up in self-absorption. In such dense clouds the neutral hydrogen has a substantially lower spin temperature than does that in the surrounding interstellar medium. The self-absorption dips were analysed assuming that the atomic hydrogen in the clouds has a Gaussian, or double Gaussian, distribution in velocity and that the spin temperature is constant throughout the cloud. It was found that the HI velocities are very close to those of the corresponding OH and H2 CO lines. The spin temperature of the HI ranges from about 16 K to about 40 K, which are much higher values than those found for the molecules in these clouds. Dissert. Abstr.

N73-21724 Illinois Univ., Urbana.
INTERSTELLAR DUST AND DISTANCES TO PLANETARY NEBULAE Ph.D. Thesis
Julie Haynes Lutz 1972 108 p
Avail: Univ. Microfilms Order No. 72-19872

UBV and H alpha data were used to construct diagrams of color excess versus distance for early type stars within 1.5 of eight planetary nebulae. These diagrams and the observed extinctions of the planetaries were used to derive distances for six of these nebulae. The diagrams were also used in conjuction with Cahn and Kaler distances for the program nebulae to derive a value of R, the ratio of total to selective absorption in the visual region, for the line of sight to each nebula.
Dissert. Abstr.

N73-21725*# TRW Systems Group, Redondo Beach, Calif.
INVESTIGATION OF HIGH SPEED PHENOMENA Final Report
D. G. Becker and J. C. Slattery Dec. 1972 93 p refs
(Contract NASw-2246)
(NASA-CR-131468; TRW-16623-6005-R0-00) Avail: NTIS HC $6.75 CSCL 03B

Experimental research is reported for laboratory simulation of meteors and meteoroid impacts on solid surfaces. Two types of mass measurements are discussed: impact ionization risetime effect and luminous efficiency measurements. F.O.S.

N73-21726*# Cornell Univ., Ithaca, N.Y. Center for Radiophysics and Space Research.
FAR INFRARED ASTRONOMY Final Report, 1 Nov. 1970 - 31 Mar. 1972
J. R. Houck Jan. 1973 10 p
(Grant NGR-33-010-139)
(NASA-CR-131512; CRSR-511) Avail: NTIS HC $3.00 CSCL 03A

The research to develop a spectrometer to be used with a ground based telescope is described. Two liquid helium cooled infrared spectrometers were designed and built. The first has a Cassegrain optical system and a variable focal length between 51.4 cm and 92.6 cm. It is capable of a resolution of 500. The second has a focal length of 19.1 cm and has a resolution of 100. Both spectrometers have been operated at 10-30 microns. Sample spectra are included. Author

N73-21727*# California Univ., Los Angeles. Space Science Center.
MAGNETOMETER INSTRUMENT TEAM STUDIES FOR THE DEFINITION PHASE OF THE OUTER PLANETS GRAND TOUR Final Report
Paul J. Coleman, Jr. 21 Mar. 1973 27 p
(Grant NGR-05-007-327)
(NASA-CR-131452)
Avail: NTIS HC $3.50 CSCL 22A

The work performed by the magnetic fields investigation team during the mission definition phases of the Outer Planets Grand Tour (OPGT) and the Mariner Jupiter Saturn (MJS) Missions is reported. This work involved three tasks: (1) defining the objectives of the magnetic fields investigations, (2) defining the magnetometer systems required to meet these objectives, and (3) developing and testing hardware elements in certain mission-specific areas.
Author

N73-21728*# Ohio State Univ. Research Foundation, Columbus.
THE OHIO STATE UNIVERSITY GEOMETRIC AND ORBITAL (ADJUSTMENT) PROGRAM (OSUGOP) FOR SATELLITE OBSERVATIONS
J. R. Reilly, C. R. Schwarz, and M. C. Whiting Dec. 1972 191 p refs
(Grant NGR-36-008-093; OSURF Proj. 2514)
(NASA-CR-131532; Rept-190) Avail: NTIS HC $11.75 CSCL 03C

A computer program, OSUGOP, developed for adjusting ground station coordinates from observations made to satellites by stations observing from the ground is outlined. The observations can be optical or ranges, and the adjustments can be performed in either the geometric or orbital mode. The program was developed in such a way that certain specific tasks can be performed without resorting to a complete solution. E.H.W.

N73-21729*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
APOLLO 16 PRELIMINARY SCIENCE REPORT
Washington 1972 636 p refs Original contains color illustrations
(NASA-SP-315) Avail: NTIS MF $0.95; SOD HC $10.25 CSCL 22A

The preliminary results of the Apollo 16 investigations are reported. Articles are presented on mission planning, geologic investigations of the lunar samples, soil mechanics, seismic experiments, cosmic ray experiments, biomedical experiments, photogeology, photogrammetry and altimetry, and astronomical photography. For individual titles, see N73-21730 through N73-21794.

N73-21730* National Aeronautics and Space Administration, Washington, D.C.
APOLLO 16 SITE SELECTION
N. W. Hinners *In its* Apollo 16 Prelim. Sci. Rept. 1972 3 p refs (For availability see N73-21729 12-30)
CSCL 22A

The selection is discussed of the Descartes landing site for the Apollo 16 flight for direct sampling of highland materials that would be compositionally different from previous samples. The lessons learned in this site selection that should be considered in future site selection are listed. F.O.S.

N73-21731* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
MISSION DESCRIPTION
Richard R. Baldwin *In its* Apollo 16 Prelim. Sci. Rept. 1972 10 p (For availability see N73-21729 12-30)
CSCL 22A

The Apollo 16 flight is described. The objectives, lunar surface activities, lunar orbital experiments, service module orbital photographic tasks, and command module photographic tasks are discussed. F.O.S.

N73-21732* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
TOPOGRAPHIC MAPPING OF THE APOLLO 16 LANDING SITE
Robert O. Hill and Merritt J. Bender *In its* Apollo 16 Prelim. Sci. Rept. 1972 2 p (For availability see N73-21729 12-30)
CSCL 22A

The techniques are described for obtaining high resolution photographs from the Apollo 14 lunar orbiter for topographic mapping of the Descartes landing site for use in planning Apollo 16. The Apollo 16 spacecraft landed approximately 250 m from the selected target point, and few topographic surprises were encountered. F.O.S.

N73-21733* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
SUMMARY OF SCIENTIFIC RESULTS
Anthony W. England *In its* Apollo 16 Prelim. Sci. Rept. 1972 8 p ref (For availability see N73-21729 12-30)
CSCL 22A

Preliminary results of the Apollo 16 lunar experiments are reported. The composition of geological samples from the landing site is discussed including the Cayley Formation and the Descartes highlands. The geological data substantiates the belief that lunar terra is underlain by plagioclase or anorthositic rocks. Other results are discussed for the following experiments: soil mechanics, passive and active seismic, lunar surface and portable magnetometer, far camera/spectrograph, solar wind composition, cosmic ray, and spectrometer. F.O.S.

N73-21734* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
PHOTOGRAPHIC SUMMARY
John W. Dietrich and Uel S. Clanton *In its* Apollo 16 Prelim. Sci. Rept. 1972 32 p Original contains color illustrations (For availability see N73-21729 12-30)
CSCL 22A

The photographic objectives and the photographic equipment of the Apollo 16 flight are described. Translunar and lunar module/lunar surface photography are presented along with the command and service module orbital and transearth photography. F.O.S.

N73-21735* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
CREW OBSERVATIONS
John W. Young, Thomas K. Mattingly, and Charles M. Duke *In its* Apollo 16 Prelim. Sci. Rept. 1972 6 p (For availability see N73-21729 12-30)
CSCL 22A

The observations by the astronauts on the Apollo 16 flight are reported. Topics discussed include: lunar orbit and landing, surface experiment deployment, lunar traverse geology, EVA-1, EVA-2, EVA-3, orbital observations, and general observations. F.O.S.

N73-21736* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
PRELIMINARY GEOLOGIC INVESTIGATION OF THE APOLLO 16 LANDING SITE
W. R. Muehlberger (Texas Univ., Austin), R. M. Batson (Geol. Surv.), E. L. Boudette (Geol. Surv.), C. M. Duke, R. E. Eggleton (Geol. Surv.), D. P. Elston (Geol. Surv.), A. W. England, V. L. Freeman (Geol. Surv.), M. H. Hait (Geol. Surv.), T. A. Hall (Geol. Surv.) et al *In its* Apollo 16 Prelim. Sci. Rept. 1972 81 p refs (For availability see N73-21729 12-30)
CSCL 22A

Preliminary results of examining the lunar rock samples from the Apollo 16 flight are reported. Topics discussed include: premission geologic studies, geologic objectives, description of the site and traverse routes, superficial deposits, and station descriptions. F.O.S.

N73-21737* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
PRELIMINARY EXAMINATION OF LUNAR SAMPLES. PART A: A PETROGRAPHIC AND CHEMICAL DESCRIPTION OF SAMPLES FROM THE LUNAR HIGHLANDS
In its Apollo 16 Prelim. Sci. Rept. 1972 23 p (For availability see N73-21729 12-30)
CSCL 22A

Chemical, petrographic, and textural characteristics of a representative collection of the Apollo 16 rock and soil samples are reported. The macroscopic and microscopic textures are the result of two or more events in the history of any given sample. Cataclastic, highly crushed rocks are common along with complex intergrowths of shock-produced glass, devitrified glass, and preexisting clasts. The dominant chemical feature is the high abundance of aluminum and calcium. In terms of their petrogenesis, the rocks are typed as cataclastically and cataclysmically modified anorthosites; igneous; and polymict breccias. F.O.S.

N73-21738* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
APOLLO 16 SPECIAL SAMPLES, PART B
Friedrich Hoerz, W. D. Carrier, III, J. W. Young, C. M. Duke, J. S. Nagle (Brown and Root-Northrop), and R. Fryxell (Washington State Univ.) *In its* Apollo 16 Prelim. Sci. Rept. 1972 31 p (For availability see N73-21729 12-30)
CSCL 03C

Information is presented concerning special samples which were collected for specific investigations. The methods of sample collection are described along with fillet and core samples. F.O.S.

N73-21739* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
CAUSE OF SECONDARY MAGNETIZATION IN LUNAR SAMPLES, PART C
G. W. Pearce (Toronto Univ.) and D. W. Strangway *In its* Apollo 16 Prelim. Sci. Rept. 1972 4 p refs (For availability see N73-21729 12-30)
CSCL 03C

The unstable component of the magnetization found in lunar samples was investigated by returning a demagnetized tracer igneous rock sample from Apollo 12 to the moon on Apollo 16. After the return of the sample, the soft component was similar to the original soft component of the first trip. It is concluded that the soft component is an artifact of the trip. F.O.S.

N73-21740* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
SOIL MECHANICS
James K. Mitchell (Calif. Univ., Berkeley), W. David Carrier, III, William N. Houston (Calif. Univ., Berkeley), Ronald F. Scott (Calif. Inst. of Tech.), Leslie G. Bromwell (MIT), H. Turan Durgunoglu (Calif. Univ., Berkeley), H. John Hovland (Calif. Univ., Berkeley), Donald D. Treadwell (Calif. Univ., Berkeley), and Nicholas C. Costes *In its* Apollo 16 Prelim. Sci. Rept. 1972 29 p refs (For availability see N73-21729 12-30)
CSCL 08M

Preliminary results are presented of an investigation of the physical and mechanical properties of lunar soil on the Descartes slopes, and the Cayley Plains in the vicinity of the LM for Apollo 16. The soil mechanics data were derived from (1) crew commentary and debriefings, (2) television, (3) lunar surface photography, (4) performance data and observations of interactions between soil and lunar roving vehicle, (5) drive-tube and deep drill samples, (6) sample characteristics, and (7) measurements using the SRP. The general characteristics, stratigraphy and variability are described along with the core samples, penetrometer test results, density, porosity and strength. F.O.S.

N73-21741* Texas Univ., Galveston.
PASSIVE SEISMIC EXPERIMENT
Gary V. Latham, Maurice Ewing, Frank Press (MIT), George Sutton (Hawaii Univ.), James Dorman, Yosio Nakamura (Gen. Dyn.), Nafi Toksoz (MIT), David Lammlein (Lamont-Doherty Geol. Obs.), and Fred Duennebier (Hawaii Univ.) *In* NASA. Lyndon B. Johnson Space Center Apollo 16 Prelim. Sci. Rept. 1972 29 p refs (For availability see N73-21729 12-30)
CSCL 22A

The design, deployment, and operation of the Apollo 16 passive seismic experiment (PSE) are discussed. Since activation, all elements of the PSE have operated as planned, with the exception of the sensor thermal control system. Significant progress in the measurement of meteoroid flux in near-earth space has been made, along with delineation of active moonquake source regions. The data obtained indicate that moonquakes are concentrated at great depth (800 to 1000 km) and that the apparent disparity between meteoroid flux estimates based on lunar crater counts and those from earth-based observations can be resolved by seismic measurements in favor of the lower flux

indicated by the crater count method. The results obtained from the PSE are summarized and their significance is discussed in detail. D.L.G.

N73-21742* Stanford Univ., Calif.
ACTIVE SEISMIC EXPERIMENT
Robert L. Kovach, Joel S. Watkins (North Carolina Univ.), and Pradeep Talwani *In* NASA. Lyndon B. Johnson Space Center Apollo 16 Prelim. Sci. Rept. 1972 14 p refs (For availability see N73-21729 12-30)
CSCL 22A

The Apollo 16 active seismic experiment (ASE) was designed to generate and monitor seismic waves for the study of the lunar near-surface structure. Several seismic energy sources are used: an astronaut-activated thumper device, a mortar package that contains rocket-launched grenades, and the impulse produced by the lunar module ascent. Analysis of some seismic signals recorded by the ASE has provided data concerning the near-surface structure at the Descartes landing site. Two compressional seismic velocities have so far been recognized in the seismic data. The deployment of the ASE is described, and the significant results obtained are discussed. D.L.G.

N73-21743* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
LUNAR SURFACE MAGNETOMETER EXPERIMENT
P. Dyal, C. W. Parkin, D. S. Colburn, and G. Schubert (Calif. Univ., Los Angeles) *In its* Apollo 16 Prelim. Sci. Rept. 1972 14 p refs (For availability see N73-21729 12-30)
CSCL 22A

The Apollo 16 lunar surface magnetometer (LSM) activation completed the network installation of magnetic observatories on the lunar surface and initiated simultaneous measurements of the global response of the moon to large-scale solar and terrestrial magnetic fields. Fossil remanent magnetic fields have been measured at nine locations on the lunar surface, including the Apollo 16 LSM site in the Descartes highlands area. This fossil record indicates the possible existence of an ancient lunar dynamo or a solar or terrestrial field much stronger than exists at present. The experimental technique and operation of the LSM are described and the results obtained are discussed. D.L.G.

N73-21744* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
LUNAR PORTABLE MAGNETOMETER EXPERIMENT
P. Dyal, C. W. Parkin, C. P. Sonett, R. L. DuBois (Okla. Univ.), and G. Simmons (MIT) *In its* Apollo 16 Prelim. Sci. Rept. 1972 8 p refs (For availability see N73-21729 12-30)
CSCL 22A

The purpose of the Apollo 16 lunar portable magnetometer (LPM) experiment is to measure the permanent magnetic field at different geological sites on the lunar surface. The LPM field measurements are a vector sum of the steady remanent field from the lunar crust and of the time-varying ambient fields. The remanent magnetic fields measured in the Descartes region are the largest extraterrestrial fields yet measured in situ. These measurements show for the first time that the Descartes highlands have a stronger remanent magnetization than do the mare regions of the previous Apollo landing sites. The experimental technique used in the LPM experiment is described and the preliminary results obtained are discussed. Author

N73-21745* Naval Research Lab., Washington, D.C.
FAR UV CAMERA/SPECTROGRAPH c14
George R. Carruthers and Thornton Page *In* NASA. Lyndon B. Johnson Space Center Apollo 16 Prelim. Sci. Rept. 1972 14 p refs (For availability see N73-21729 12-30)
CSCL 14B

The far UV camera/spectrograph deployed in the Apollo 16 mission recorded light in the invisible band of wavelengths between 50 and 160 nm, approximately one-third the wavelength that can penetrate the atmosphere of the earth to ground based telescopes. The photographs obtained show hydrogen and other gases in the solar wind and interplanetary media, and provide new data on stars, nebulae, and galaxies. The instrument is described, the experimental goals outlined, and the preliminary results discussed. D.L.G.

N73-21746* Bern Univ. (Switzerland). Physikalisches Inst.
SOLAR WIND COMPOSITION EXPERIMENT c29
J. Geiss, F. Buehler, H. Cerutti, P. Eberhardt, and Ch. Filleux *In* NASA. Lyndon B. Johnson Space Center Apollo 16 Prelim. Sci. Rept. 1972 10 p refs (For availability see N73-21729 12-30)
CSCL 03C

The Apollo 16 SWC experiment is a continuation of the earlier experiments; however, an essential change was introduced in the solar wind particle collection technique. Platinum surfaces were incorporated in the collector foil, and use was made of a layer technique for distinguishing particles of different energies and different directions of arrival. The improvements and the expanded scope of the Apollo 16 experiment, relative to the earlier SWC experiments, can be summarized as follows: elimination of possible residual dust contamination by treating the platinum foil sections with dilute hydrofluoric acid before analysis; increased accuracy of solar wind argon abundance; determination of solar wind albedo; and search for helium in the energy range above approximately 40 KeV/nucleon. Author

N73-21747* General Electric Co., Philadelphia, Pa.
COSMIC RAY EXPERIMENT. PART A: COMPOSITION AND ENERGY SPECTRA OF SOLAR COSMIC RAY NUCLEI c29
R. L. Fleischer and H. R. Hart, Jr. *In* NASA. Lyndon B. Johnson Space Center Apollo 16 Prelim. Sci. Rept. 1972 9 p (For availability see N73-21729 12-30)
CSCL 03C

The GE experiment consisted of two types of detectors: plastics and glasses located in panel 2 and the lower half of panel 3. In panel 2, the entire exposed detector area of 14.7 by 22.6 cm was composed of 31 sheets of 0.025-cm polycarbonate plastic 9070-112. In panel 3, 39 sheets of 0.02-cm cellulose triacetate with no plasticizer made up the major volume fraction. The lower part of panel 3 contained five types of glass detectors. Particles that entered the array after it was folded were recognized, if they crossed from one sheet to another, by means of a 2-mm relative shift of alternate sheets. Author

N73-21748* California Univ., Berkeley.
COMPOSITION OF INTERPLANETARY PARTICLES AT ENERGIES FROM 0.1 TO 150 MeV/NUCLEON, PART B c29
P. B. Price, D. Braddy, D. OSullivan, and J. D. Sullivan *In* NASA. Lyndon B. Johnson Space Center Apollo 16 Prelim. Sci. Rept. 1972 8 p (For availability see N73-21729 12-30)
CSCL 03C

During the Apollo 16 mission, a solar flare produced an enormous amount of low-energy nuclei, many orders of magnitude greater than the level inferred from studies of tracks in the window of the Apollo 12 spacecraft during a time when the sun was quiet. The differential energy spectrum of nuclei with Z less than or equal to 6 falls by seven orders of magnitude over the interval from 0.1 to 20 MeV/nucleon, then remains almost flat up to approximately 100 MeV/nucleon. The two parts correspond to contributions from the sun and from galactic cosmic rays. Any maximum in the spectrum occurs below the lowest energy studied. Author

N73-21749* California Inst. of Tech., Pasadena.
SOLAR COSMIC RAY, SOLAR WIND, SOLAR FLARE, AND NEUTRON ALBEDO MEASUREMENTS, PART C c29
D. Burnett, C. Hohenberg (Washington Univ., St. Louis), M. Maurette (CNRS, Orsay, France), M. Monnin (Clermont-Ferrand Univ.), R. Walker, and D. Wollum *In* NASA. Lyndon B. Johnson Space Center Apollo 16 Prelim. Sci. Rept. 1972 14 p refs (For availability see N73-21729 12-30)
CSCL 03C

All mineral detectors exposed on Apollo 16 had high surface track densities probably produced by a solar flare that occurred during the mission. The heavy ions followed a power law spectrum with exponent approximately 3 down to approximately 200 KeV/nucleon. The abundance of low-energy particle tracks observed in this flare may explain the high track densities observed in lunar dust grains. Pristine heavy-particle tracks in feldspar give long tracks. Shallow pits similar to those expected from extremely heavy solar wind ions were observed

in about the expected number. Initial results give a low apparent value of neutron albedo relative to theory. Author

N73-21750* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
GEGENSCHEIN-MOULTON REGION PHOTOGRAPHY FROM LUNAR ORBIT
L. Dunkelman, C. L. Wolff, and R. D. Mercer (Dudley Obs.) *In its* Apollo 16 Prelim. Sci. Rept. 1972 4 p refs (For availability see N73-21729 12-30)
CSCL 03C

Apollo 16 photography during lunar orbit of the Gegenschein-Moulton region was used to determine the libration points of the Sun-Earth system. Triangulation for the system is discussed, along with background experimental information. J.A.M.

N73-21751* State Univ. of New York, Albany.
UV PHOTOGRAPHY OF THE EARTH AND MOON c14
Tobias Owen *In* NASA. Lyndon B. Johnson Space Center Apollo 16 Prelim. Sci. Rept. 1972 5 p refs (For availability see N73-21729 12-30)
CSCL 14E

This experiment obtained imagery of the earth and the moon at a series of wavelength intervals in the near ultraviolet. These photographs were used to aid in the interpretation of the UV appearance of other planets in the solar system, especially Mars and Venus. The filter and film characteristics are described, as well as the ozone absorption coefficient curve. J.A.M.

N73-21752* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
GAMMA RAY SPECTROMETER EXPERIMENT c14
James R. Arnold (Calif. Univ., San Diego), Albert E. Metzger (JPL), Laurence E. Peterson (Calif. Univ., San Diego), Robert C. Reedy (Calif. Univ., San Diego), and J. I. Trombka *In its* Apollo 16 Prelim. Sci. Rept. 1972 8 p refs (For availability see N73-21729 12-30)
CSCL 14B

The transearth coast period of the Apollo 16 mission provided an opportunity to study the astronomical sources of gamma radiation. This experiment was used to aid compositional identification for geochemical mapping of the lunar surface. J.A.M.

N73-21753* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
X-RAY FLUORESCENCE EXPERIMENT c14
I. Adler, J. I. Trombka, J. Gerard, P. Lowman, R. Schmadebeck, H. Blodget, E. Eller, L. Yin, R. Lamothe, G. Osswald et al *In its* Apollo 16 Prelim. Sci. Rept. 1972 14 p refs (For availability see N73-21729 12-30)
CSCL 14B

The X-ray fluorescence spectrometer, carried in the scientific instrument module bay of the command and service module, was used for orbital mapping of the lunar surface composition and X-ray galactic observations during transearth coast. The lunar surface measurements involved observations of the intensity and characteristic energy distribution of the secondary or fluorescent X-rays produced by the interaction of solar X-rays with the lunar surface. The astronomical observations consisted of relatively long periods of X-ray measurement of preselected galactic sources such as Cygnus (Cyg X-1) and Scorpius (Sco X-1). Author

N73-21754* American Science and Engineering, Inc., Cambridge, Mass.
ALPHA-PARTICLE SPECTROMETER EXPERIMENT c14
Paul Gorenstein and Paul Bjorkholm *In* NASA. Lyndon B. Johnson Space Center Apollo 16 Prelim. Sci. Rept. 1972 6 p refs (For availability see N73-21729 12-30)
CSCL 14B

Observation of lunar radon emanation during the Apollo 15 and 16 missions shows the existence of areas with locally high emanation rates. The most conspicuous Rn-222 feature found in the data analysis is a region that includes Aristarchus Crater. The excess emanating power of the Aristarchus region may be an indication of internal activity at that site. There are regions with anomalously high rates of Po-210 activity, which indicates transient phenomena involving the release of Rn-222 gas from certain areas of the moon. Author

N73-21755* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
LUNAR ORBITAL MASS SPECTROMETER EXPERIMENT c14
R. R. Hodges (Texas Univ., Dallas), J. H. Hoffman (Texas Univ., Dallas), and D. E. Evans *In its* Apollo 16 Prelim. Sci. Rept. 1972 6 p refs (For availability see N73-21729 12-30)
CSCL 14B

A lunar orbital mass spectrometer carried by the Apollo 16 command and service module was used to detect the lunar atmosphere and to search for active lunar volcanism. The experimental procedure and results are described. J.A.M.

N73-21756* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
SUBSATELLITE MEASUREMENTS OF PLASMA AND ENERGETIC PARTICLES c25
K. A. Anderson (Calif. Univ., Berkeley), L. M. Chase (Calif. Univ., Berkeley), R. P. Lin (Calif. Univ., Berkeley), J. E. McCoy, and R. E. McGuire (Calif. Univ., Berkeley) *In its* Apollo 16 Prelim. Sci. Rept. 1972 6 p refs (For availability see N73-21729 12-30)
CSCL 20I

The Apollo 16 particles and fields subsatellite is instrumented to measure (1) plasma and energetic-particle fluxes, (2) vector magnetic fields, and (3) velocity of the subsatellite to a high precision for the purpose of determining lunar gravitational anomalies. Results from the magnetic-field and gravitational-field experiments are discussed. The results obtained from the plasma and energetic-particle detectors are discussed briefly. The plasma and energetic-particles experiment describes the various plasma regimes in which the moon moves, and determines how the moon interacts with the plasma and magnetic fields in the environment. Author

N73-21757* California Univ., Los Angeles.
THE PARTICLES AND FIELDS SUBSATELLITE MAGNETOMETER EXPERIMENT c14
P. J. Coleman, Jr., B. R. Lichtenstein, C. T. Russell, G. Schubert, and L. R. Sharp *In* NASA. Lyndon B. Johnson Space Center Apollo 16 Prelim. Sci. Rept. 1972 13 p refs (For availability see N73-21729 12-30)
CSCL 14B

It is reported that the objectives of the particles and fields subsatellite (PFS) magnetometer experiment are to calculate the interior electrical conductivity of the moon, to survey the remanent magnetization of the lunar surface, and to study the interaction of the moon with its plasma environment. The magnetometers also support the PFS particle experiment by providing onboard magnetic sectoring and a posteriori pitch angle data and plasma diagnostics. Author

N73-21758* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
S BAND TRANSPONDER EXPERIMENT c09
W. L. Sjogren (JPL), P. M. Muller (JPL), and W. R. Wollenhaupt *In its* Apollo 16 Prelim. Sci. Rept. 1972 7 p refs (For availability see N73-21729 12-14)
CSCL 09A

It is reported that this experiment measures the lunar gravitational field, which in turn provides information on the distribution of lunar mass and its correlation with surface features such as craters, mountains, and maria. The lunar gravitational field is measured by observing the dynamical motion of spacecraft in free-fall orbits. Effective detection of mass variations is greatly enhanced by low-altitude trajectories, such as the eccentric orbits during revolutions 3 to 16 of the Apollo 16 spacecraft and the 11 km periapsis of the Apollo 16 subsatellite during May 1972. The observational data are the precise earth-based radio tracking measurements initially used for real-time navigation. Author

N73-21759* Stanford Univ., Calif.
BISTATIC-RADAR INVESTIGATION c07
H. T. Howard and G. L. Tyler *In* NASA. Lyndon B. Johnson Space Center Apollo 16 Prelim. Sci. Rept. 1972 13 p (For

availability see N73-21729 12-30)
CSCL 17I

The purpose of the reported experiment was to determine the principal electromagnetic and structural properties of the lunar surface from the observation of command and service module (CSM) radio transmissions that were reflected from the lunar surface and received on earth. These transmissions emanate from the CSM communication systems at wavelengths of 13 cm (S-band) and 116 cm (very high frequency (VHF)). Lunar crustal properties such as dielectric constant, average slope and slope probability, density, small-scale surface roughness, and embedded rocks to a depth of 20 m may be determined. The results are proving to be most useful in understanding the processes that have produced and modified the crust and in distinguishing between adjacent and subjacent geological units. The experimental observations are also of intrinsic interest in the study of electromagnetic scattering. Author

N73-21760* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
APOLLO WINDOW METEOROID EXPERIMENT
Burton G. Cour-Palais, Milton L. Brown (Lockheed Electron. Corp.), and David S. McKay *In its* Apollo 16 Prelim. Sci. Rept. 1972 10 p refs (For availability see N73-21729 12-30)
CSCL 03C

The Apollo window meteoroid experiment is described which uses the Apollo command module heat shield window surfaces to obtain information about the flux of meteoroids with masses of 10 to the minus 7th power g and less; to examine the residue and the morphology of the craters produced by these meteoroids; to obtain information regarding the dynamic and physical properties of the meteoroids; and to discover possible correlations with the lunar-rock-crater studies. Photographs are included. Author

N73-21761* Johann-Wolfgang-Goethe-Universitaet, Frankfurt am Main (West Germany).
BIOMEDICAL EXPERIMENTS. PART A: BIOSTACK EXPERIMENT c04
Horst Buecker, G. Horneck, E. Reinholz (Max Planck Inst. fuer Biophys., Frankfurt), W. Scheuermann (Tech. Hochschule, Hanover), W. Ruether (Marburg Univ.), E. H. Graul (Marburg Univ.), H. Planel (Toulouse Univ.), J. P. Soleilhavoup (Toulouse Univ.), P. Cuer (Strasbourg Univ.), R. Kaiser (Strasbourg Univ.) et al *In* NASA. Lyndon B. Johnson Space Center Apollo 16 Prelim. Sci. Rept. 1972 10 p refs (For availability see N73-21729 12-30)
CSCL 06B

The biostack experiment is described which was designed to study the biologic effects of individual heavy nuclei of galactic cosmic radiation during space flight outside the magnetosphere of the earth. Specifically, the biostack experiment was designed to promote research on the effects of high energy/high Z particles of galactic cosmic radiation on a broad spectrum of biologic systems, from the molecular to the highly organized and developed forms of life. The experiment was considered unique and scientifically meritorious because of its potential yield of information—currently unavailable on earth—on the interaction of biologic systems with the heavy particles of galactic cosmic radiation. Author

N73-21762* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
MICROBIAL RESPONSE TO SPACE ENVIRONMENT, PART B c04
G. R. Taylor, C. E. Chassay, W. L. Ellis (Northrop Serv., Inc.), B. G. Foster (Tex. A&M Univ.), P. A. Volz (Eastern Mich. Univ.), J. Spizizen (Scripps Clinic and Res. Found.), H. Buecker (Frankfurt Univ.), R. T. Wrenn (Northrop Serv., Inc.), R. C. Simmonds, R. A. Long (Northrop Serv., Inc.) et al *In its* Apollo 16 Prelim. Sci. Rept. 1972 6 p (For availability see N73-21729 12-30)
CSCL 06M

The performance of the microbial response to space environment experiment is considered excellent by all investigators. For most microbial systems, only preliminary survival data are available at this time. None of the available data indicate space flight-mediated changes in cell viability or recovery. One quite important observation has been made at this early date, however. The eggs produced after mice had been infected with N. dubius larvae demonstrated a significant decrease in hatchability when compared to identical ground controls. Except for the fact that the Apollo 16 flight larvae had been on board the command module, treatment of the flown larvae and ground control larvae was the same; neither had been exposed to UV irradiation. The significance and implications of this finding are currently being studied. Author

N73-21763* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
VISUAL LIGHT FLASH PHENOMENON, PART C c04
Richard E. Benson and Lawrence S. Pinsky *In its* Apollo 16 Prelim. Sci. Rept. 1972 4 p refs (For availability see N73-21729 12-30)
CSCL 06P

The Apollo 16 mission provided the opportunity to obtain additional data on the characteristics and frequency of the light flashes and also provided the first opportunity to obtain a direct physical record of incident cosmic ray particles with the Apollo light-flash moving emulsion detector (ALFMED). The ALFMED is an electromechanical device that is worn on the head like a helmet and supports cosmic radiation-sensitive emulsions around the head of the test subject. Two light-flash observation sessions were conducted during the mission: one during translunar coast and the second during transearth coast. Characteristics of the light flashes observed and reported by the Apollo crew members were generally similar to those reported on previous missions. Analyses of the ALFMED emulsion plates are proceeding as scheduled, although results are not yet available. The ALFMED results should provide conclusive evidence establishing the correlation, if any, between the incident cosmic ray particles and the perception of light flashes as reported by Apollo crew members. A.L.

N73-21764* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
OBSERVATIONS AND IMPRESSIONS FROM LUNAR ORBIT
Thomas K. Mattingly, Farouk El-Baz (Bell Telephone Labs.), and Richard A. Laidley *In its* Apollo 16 Prelim. Sci. Rept. 1972 16 p (For availability see N73-21729 12-30)
CSCL 22A

On Apollo 16, the command module pilot made observations of particular surface features and processes to complement photographic and other remotely sensed data. Emphasis was placed on geological problems that required the extreme dynamic range and color sensitivities of the human eye; repetitive observations of varying sun angles and viewing directions; and, in some cases, on-the-scene interpretations. Visual observations and impressions recorded during the mission verified the effectiveness of the hardware and techniques used. The orbiting observer functioned both as a sensor, in otherwise inaccessible areas such as earthshine and shadows, and as a designator of potentially significant data that were acquired on the photographic record. A.L.

N73-21765* Geological Survey, Washington, D.C.
PHOTOGEOLOGY. PART A: RELATIVE AGES OF SOME NEAR-SIDE AND FAR-SIDE TERRA PLAINS BASED ON APOLLO 16 METRIC PHOTOGRAPHY
Laurence A. Soderblom and Joseph M. Boyce *In* NASA. Lyndon B. Johnson Space Center Apollo 16 Prelim. Sci. Rept. 1972 4 p (For availability see N73-21729 12-30)
CSCL 03C

Relative age measurements were made for 14 light plains areas, using 30X enlargements of Apollo 16 metric camera photography. Results indicate that: (1) Crater morphology and frequency studies consistently indicate that the Fra Mauro Formation has received 2.5 to 3 times as much impact flux as the Cayley Formation. (2) Crater counts and relative age dating indicate that the Cayley Formation is only slightly older than the oldest mare units. (3) Assuming the rubidium-strontium ages of Apollo 14 basalt breccias give minimum age for Fra Mauro Formation, the Cayley Formation must have been generated throughout a period of less than 100 million years, approximately 3.8 to 3.9 billion years ago. (4) The Cayley Formation ages obtained on the near side and far side are the same, indicating a synchrony throughout the moon in these units. (5) The linear

relationship as predicted by the small impact erosion model between net accumulated flux and the maximum diameter of a crater that could be eroded below recognition is confirmed.
Author

N73-21766* Geological Survey, Washington, D.C.
CAYLEY FORMATION INTERPRETED AS BASIN EJECTA, PART B
R. E. Eggleton and G. G. Schaber *In* NASA. Lyndon B. Johnson Space Center Apollo 16 Prelim. Sci. Rept. 1972 9 p (For availability see N73-21729 12-30)
CSCL 03C

Improved information on the morphology and distribution of the Cayley Formation, provided by Apollo 16 orbital photography, leads to a concept in which the Cayley Formation was deposited as fluidized debris that traveled beyond the presently recognizable extent of the Imbrium Basin ejecta. By this hypothesis, each basin-forming event produced thick plains deposits in a belt peripheral to the continuous ejecta blanket and may have deposited a thinner layer in pools over the entire moon. Thus, each patch of terra plains is likely to be underlain by a sequence of fluidized ejecta deposits, which were derived from most or all multiring basins younger than the occupied depression. If the light color of the plains results from a high feldspar content of the excavated crustal rocks, an explanation of the absence of exposed pre-Cayley mare rocks may be that they are buried or dusted over. A.L.

N73-21767* Bell Telephone Labs., Inc., New York.
SMALL SCALE ANALOGS OF THE CAYLEY FORMATION AND DESCARTES MOUNTAINS IN IMPACT ASSOCIATED DEPOSITS, PART C
James W. Head *In* NASA. Lyndon B. Johnson Space Center Apollo 16 Prelim. Sci. Rept. 1972 4 p (For availability see N73-21729 12-30)
CSCL 03C

The exploration of the Cayley Formation and material of the Descartes Mountains and an understanding of the origin and evolution of these units were primary objectives of the Apollo 16 lunar mission. This section examines several areas associated with impact crater deposits that show small-scale features similar in morphology to the regional characteristics of the Cayley and Descartes units shown in the Apollo 16 photography. Author

N73-21768* Geological Survey, Washington, D.C.
DESCARTES HIGHLANDS: POSSIBLE ANALOGS AROUND THE ORIENTALE BASIN, PART D
Ann Hodges Carroll *In* NASA. Lyndon B. Johnson Space Center Apollo 16 Prelim. Sci. Rept. 1972 4 p (For availability see N73-21729 12-30)
CSCL 03C

Two possible analogs, although not entirely satisfactory, offer reasonable alternatives to the volcanic interpretation of the Descartes highlands. Reconsideration of this complex terrain, prompted by the preliminary results of the Apollo 16 mission, will lead to the revision of some theories on lunar volcanism and also to a better understanding of the landforms caused by the formation of multiring basins. Author

N73-21769* Bell Telephone Labs., Inc., New York.
ORIENTALE BASIN DEPOSITS (RICCIOLI AREA) IN APOLLO 16 EARTHSHINE PHOTOGRAPHY, PART E
D. D. Lloyd and J. W. Head *In* NASA. Lyndon B. Johnson Space Center Apollo 16 Prelim. Sci. Rept. 1972 3 p (For availability see N73-21729 12-30)
CSCL 03C

Interpretations of photography of Orientale Basin deposits obtained under earthshine illumination conditions during the Apollo 16 mission are presented. Although the quality of these photographs is less than that obtainable in sunshine, these regions are in the dark during Apollo missions because of the locations of the Apollo landing sites. Photography of these regions under different lighting geometry and from different viewpoints is therefore a useful addition to previous photographic data. Oblique photography was obtained of Riccioli Crater and adjacent areas, which lie northeast of the Orientale Basin. Author

N73-21770* Geological Survey, Washington, D.C.
REINTERPRETATIONS OF THE NORTHERN NECTARIS BASIN, PART F
Don E. Wilhelms *In* NASA. Lyndon B. Johnson Space Center Apollo 16 Prelim. Sci. Rept. 1972 4 p (For availability see N73-21729 12-30)
CSCL 03C

Photogeologic analysis was attempted on a strip of Apollo 16 metric photographs; the superior quality and stereographic properties of the photography permitted this reevaluation. Geologic contacts, as redrawn, closely resemble those of earlier maps, but some differences resulted because of improved photographic quality and a conscious attempt to test fully the impact hypothesis. All or most of the nonmare material of the region of the northern Nectaris Basin rim can be explained by the formation of impact basins. This interpretation seems strained only for some irregular and clustered craters north of Mare Nectaris and for the southern facies of the Descartes material. If the latter material is shown to have been sampled and to be of impact origin, then extensive hill and crater-forming volcanic material of Imbrian or younger age probably does not exist on the lunar terra. A.L.

N73-21771* Geological Survey, Washington, D.C.
STRUCTURAL ASPECTS OF IMBRIUM SCULPTURE, PART G
David H. Scott *In* NASA. Lyndon B. Johnson Space Center Apollo 16 Prelim. Sci. Rept. 1972 2 p (For availability see N73-21729 12-30)
CSCL 03C

Apollo 16 metric photographs taken at low to high sun angles provided the first stereographic coverage of the distinctive landforms collectively referred to as Imbrium sculpture. The sculpture consists of a series of nearly linear ridges and troughs extending radially outward for more than 1000 km from the rim of the Imbrium Basin. The origin of the ridges and troughs, whether by deposition and impact scoring by fluidized clouds of ejecta from the Imbrium Basin or by faulting and volcanism during and subsequent to basin formation, is controversial. Evidence indicative of the mode of origin of Imbrium sculpture is summarized as follows. Evidence of volcano-tectonic mode of origin is favored by: (1) wide variation in relative age of parts of the sculpture; (2) furrows without rims; (3) absence of ballistic shielding; (4) asymmetry of sculpture; (5) absence of randomly oriented clusters; and (6) association with other features of structural origin. An origin by ejecta scoring and deposition is favored by the gradational ejecta with a Fra Mauro-type texture. Features that are ambiguous as to mode or origin are furrows made of coalesced crater chains and prominent rims on furrows. A.L.

N73-21772* Bell Telephone Labs., Inc., New York.
DISCOVERY OF TWO LUNAR FEATURES, PART H
Farouk El-Baz *In* NASA. Lyndon B. Johnson Space Center Apollo 16 Prelim. Sci. Rept. 1972 6 p (For availability see N73-21729 12-30)
CSCL 03C

Study of the Apollo 16 photographs resulted in the discovery of two large features in the far side highlands near the eastern limb of the moon not indicated on existing lunar maps and charts. The larger unnamed feature is a three-ringed 1000 km diameter basin, and the smaller feature is a 200 km diameter crater that is located between the eastern middle and outer rings of this basin. This crater surrounds Becvar Crater. Since these newly discovered features are large enough and significant enough to warrant the assignment of names, the following names have been recommended to the Committee on Nomenclature of the IAU for consideration. Arabia is the name suggested for the newly found basin, to honor Arab contributions to astronomy. Rupes Sibericus (Siberian Scarp) is suggested for the 1 km high scarp that borders the eastern part of the middle ring of the basin. Rupes Apalaches (Appalachian Scarp) was suggested for the 2 km high scarp that borders the western part of the middle ring of the basin. Necho has been suggested for the new-found 200 km diameter crater between the eastern middle and outer rings of the basin. A.L.

N73-21773* Arizona Univ., Tucson. Lunar and Planetary Lab.
ARTIFICIAL LUNAR IMPACT CRATERS: FOUR NEW IDENTIFICATIONS, PART I
Ewen A. Whitaker *In* NASA. Lyndon B. Johnson Space Center Apollo 16 Prelim. Sci. Rept. 1972 6 p (For availability see N73-21729 12-30)
CSCL 03C

The Apollo 16 panoramic camera photographed the impact locations of the Ranger 7 and 9 spacecraft and the S-4B stage of the Apollo 14 Saturn launch vehicle. Identification of the Ranger craters was very simple because each photographed its target point before impact. Identification of the S-4B impact crater proved to be a simple matter because the impact location, as derived from earth-based tracking, displayed a prominent and unique system of mixed light and dark rays. By using the criterion of a dark ray pattern, a reexamination of the Apollo 14 500 mm Hasselblad sequence taken of the Apollo 13 S-4B impact area was made. This examination quickly led to the discovery of the ray system and the impact crater. The study of artificial lunar impact craters, ejecta blankets, and ray systems provides the long-needed link between the various experimental terrestrial impact and explosion craters, and the naturally occurring impact craters on the moon. This elementary study shows that lunar impact crater diameters are closely predictable from a knowledge of the energies involved, at least in the size range considered, and suggests that parameters such as velocity may have a profound effect on crater morphology and ejecta blanket albedo. A.L.

N73-21774* Geological Survey, Washington, D.C.
RANGER AND OTHER IMPACT CRATERS PHOTOGRAPHED BY APOLLO 16, PART J
H. J. Moore *In* NASA. Lyndon B. Johnson Space Center Apollo 16 Prelim. Sci. Rept. 1972 6 p ref (For availability see N73-21729 12-30)
CSCL 03C

The Apollo 16 crew photographed an unusual variety of impact craters, including the two craters produced by the impacts of Ranger 7 and 9 spacecraft, small craters produced by boulders as they bounced downslope, craters with marked bilateral symmetry, and primary craters with a wide range of morphologies and sizes. Ranger impact craters and examples of other craters are briefly discussed. This photography has supplied important new data on craters in the lunar surface. Continued study of these craters and use of the metrical capabilities of the metric and panoramic camera photography will yield additional scientific results on lunar craters. A.L.

N73-21775* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
LUNAR SECONDARY CRATERS, PART K
Verne R. Overbeck, Robert H. Morrison, and John Wedekind *In its* Apollo 16 Prelim. Sci. Rept. 1972 5 p ref (For availability see N73-21729 12-30)
CSCL 03C

Formation of V-shaped structures surrounding the fresh Copernicus Crater and its secondary craters is reviewed, and preliminary observations of the more extensively eroded secondary crater field of Theophilus are presented. Results of laboratory simulation of secondary lunar craters to examine their effects on V-shaped ridges are also described. A.L.

N73-21776* Geological Survey, Washington, D.C.
CRATER MORPHOMETRY, PART L
Richard J. Pike *In* NASA. Lyndon B. Johnson Space Center Apollo 16 Prelim. Sci. Rept. 1972 6 p ref (For availability see N73-21729 12-30)
CSCL 03C

Morphometric analysis of lunar craters complements the more traditional photointerpretive study of crater morphology. A sampling is presented of morphometric results for five selected medium-sized craters photographed on the Apollo 16 mission: Madler, Langrenus B, Isidorus, Capella, and King. Apollo metric camera data present the first real opportunity to evaluate previous topographic measurements in terms of accuracy rather than in terms of precision. This method of generating crater measurements furnishes far more complete data than does the shadow-length method that yielded most of the previous morphometric information on lunar craters. A.L.

N73-21777* Bell Telephone Labs., Inc., New York.
KING CRATER AND ITS ENVIRONS, PART M
Farouk El-Baz *In* NASA. Lyndon B. Johnson Space Center Apollo 16 Prelim. Sci. Rept. 1972 8 p (For availability see N73-21729 12-30)
CSCL 03C

Superb photographs of King Crater were returned by the Apollo 16 crew. The metric and panoramic cameras provided stereoscopic coverage with which high quality topographic maps may be made. King Crater, approximately 75 km in diameter and, on the average, 3.8 km deep, is among the most significant features photographed and visually studied from lunar orbit on the Apollo 16 mission. It is the freshest crater on the far side in its size range and has several unique characteristics. (1) Although its ejecta blanket displays very sharp features, the crater does not appear to have extensive ray systems and secondary crater chains. (2) As depicted for the first time by Apollo 16 photographs, the ejecta blanket is strewn with numerous flow fronts and scarps. (3) A flat and smooth, dark, lavalike deposit 15 km across is on the northern rim of the crater. (4) The central peak of the crater is a Y-shaped structure that begins at the southern rim. (5) Bright units that are aligned with the central peak on the northern wall and rim suggest that a preexisting tabular body was excavated by the cratering process. A.L.

N73-21778* Geological Survey, Washington, D.C.
EJECTA BLANKETS OF LARGE CRATERS EXEMPLIFIED BY KING CRATER, PART N
Keith A. Howard *In* NASA. Lyndon B. Johnson Space Center Apollo 16 Prelim. Sci. Rept. 1972 8 p refs (For availability see N73-21729 12-30)
CSCL 03C

Investigations were made into the details of ejecta blankets of large fresh craters in an effort to provide insight into deposition mechanics and sequence of impact debris emplacement. King Crater, photographed by Apollo 16, served as the investigative tool. E.H.W.

N73-21779* State Univ. of New York, Genesco.
SELECTED VOLCANIC AND SURFICIAL FEATURES, PART O
R. A. Young, W. J. Brennan, and R. W. Wolfe *In* NASA. Lyndon B. Johnson Space Center Apollo 16 Prelim. Sci. Rept. 1972 1 p (For availability see N73-21729 12-30)
CSCL 03C

Metric camera photographs are used to analyze volcanic and surficial features of the lunar surface between Mare Smythii and King Crater. Patterns created by lava flows, ejecta blankets, impact debris, and fissures are discussed in detail. Possible causes of each phenomenon are suggested. E.H.W.

N73-21780* State Univ. of New York, Genesco.
LUNAR VOLCANISM: MARE RIDGES AND SINUOUS RILLES, PART P
Richard A. Young *In* NASA. Lyndon B. Johnson Space Center Apollo 16 Prelim. Sci. Rept. 1972 1 p (For availability see N73-21729 12-30)
CSCL 03C

Additional evidence of the volcanic origin of mare ridges and sinuous rilles is provided by near-terminator photography of the Herigonius Rille area (12 deg S 37 deg W) northeast of Gassendi Crater. A possible genetic relationship between ridges and rilles is illustrated. From the figure, the following relationships are evident. (1) The most prominent rille crosses several ridges without distortion, which indicates that the mare ridges did not form after the sinuous rilles. (2) The rilles could not have formed by flow up and over the ridges. (3) The rilles extend from their widest ends toward distinctly lower elevations, and the largest one branches both north and south from the vent area. Elevations are evident in stereographic views that clearly indicate the local slopes. (4) The wider end of each rille is marked by an elongate vent (?) near the summit of the mare ridge from which the rille appears to issue. (5) The two most prominent rilles join south

of the vent area and continue southward for more than 130 km. Author

N73-21781* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
PLANIMETRIC SHAPES OF LUNAR RILLES, PART Q
Verne R. Oberbeck, Michio Aoyagi, Ronald Greeley, and Michael Lovas *In its* Apollo 16 Prelim. Sci. Rept. 1972 9 p (For availability see N73-21729 12-30)
CSCL 03C

Selected Apollo 16 photographs of lunar rilles have been analyzed with a new technique that includes a finite Fourier analysis. Preliminary results suggest that it will be possible to classify rilles quantitatively by their planimetric shape. Shapes of possible terrestrial analogs for lunar rilles also can be compared to the shapes of lunar rilles by using this new technique. Preliminary results also suggest that the new technique may be useful for demonstrating structural control of shape of lunar rilles. Author

N73-21782* State Univ. of New York, Genesco.
LUNAR VOLCANISM: FRACTURE PATTERNS AND RILLES IN MARGINAL PREMARE CRATERS, PART R
Richard A. Young *In* NASA. Lyndon B. Johnson Space Center Apollo 16 Prelim. Sci. Rept. 1972 1 p (For availability see N73-21729 12-30)
CSCL 03C

Probable causes, distributions, and nature of fracture patterns of Type 3 craters around the margins of major maria are investigated. E.H.W.

N73-21783* Geological Survey, Washington, D.C.
MARE RIDGES AND ARCHES IN SOUTHERN OCEANUS PROCELLARUM, PART S
George W. Colton, Keith A. Howard, and Henry J. Moore *In* NASA. Lyndon B. Johnson Space Center Apollo 16 Prelim. Sci. Rept. 1972 3 p (For availability see N73-21729 12-30)
CSCL 03C

Stereoscopic lunar photographs were used to study the form of mare ridges and arches, their relative ages, and their association with fractures and sinuous rilles in the Southern Oceanus Procellarum. E.H.W.

N73-21784* Bell Telephone Labs., Inc., New York.
THE ALHAZEN TO ABUL WAFA SWIRL BELT: AN EXTENSIVE FIELD OF LIGHT COLORED, SINUOUS MARKINGS, PART T
Farouk El-Baz *In* NASA. Lyndon B. Johnson Space Center Apollo 16 Prelim. Sci. Rept. 1972 4 p (For availability see N73-21729 12-30)
CSCL 03C

Problematic causes and characteristics of light-colored sinuous markings on the lunar surface are explored. Two processes, exogenetic and endogenetic, are examined in detailed. During the endogenetic process it is suggested that impact ejecta deposition and surface disturbances cause the markings. During the endogenetic process, it is suggested that extrusive volcanism and sublimation and/or alteration cause the markings. E.H.W.

N73-21785* Bell Telephone Labs., Inc., New York.
LOW RELIEF FEATURES IN TERRAIN OF THE DESCARTES REGION AND OTHER AREAS: NEAR TERMINATOR PHOTOGRAPHY, PART U
J. W. Head and D. D. Lloyd *In* NASA. Lyndon B. Johnson Space Center Apollo 16 Prelim. Sci. Rept. 1972 7 p (For availability see N73-21729 12-30)
CSCL 03C

Primary efforts were made to outline areas where low-relief features in the Apollo 16 landing site and associated plains and mare units were intensified in near-terminator photography. A description and, in some cases, a preliminary interpretation of several of these areas is included in an attempt to provide additional data relevant to the interpretation of the hills, plains, and associated units investigated on the Apollo 16 mission. Near-terminator photography for areas discussed is listed in a table. Author

N73-21786* Arizona Univ., Tucson. Lunar and Planetary Lab.
COLOR CONTRASTS IN MARE NUBIUM AND THE SOUTHERN OCEANUS PROCELLARUM, PART V
Ewen A. Whitaker *In* NASA. Lyndon B. Johnson Space Center Apollo 16 Prelim. Sci. Rept. 1972 1 p (For availability see N73-21729 12-30)
CSCL 03C

The distribution of subtle but definite color variations on the lunar surface is analyzed using Apollo 16 photographs. Results show the strongest color variations and most distinct boundaries are concentrated in the northwest quadrant of the moon, where major boundaries correspond with distal fronts of a complex and prominent series of lava flows. E.H.W.

N73-21787* Massachusetts Inst. of Tech., Cambridge. Haystack Observatory
APOLLO 16 LANDING SITE: SUMMARY OF EARTH BASED REMOTE SENSING DATA, PART W
S. H. Zisk, Harold Masursky (Geol. Surv.), D. J. Milton (Geol. Surv.), G. G. Schaber (Geol. Surv.), R. W. Shorthill (Boeing Co.), and T. W. Thompson (JPL) *In* NASA. Lyndon B. Johnson Space Center Apollo 16 Prelim. Sci. Rept. 1972 5 p ref (For availability see N73-21729 12-30)
CSCL 03C

Infrared and radar studies of the Apollo 16 landing site are summarized. Correlations and comparisons between earth-based remote sensing data, IR observations, and other data are discussed in detail. Remote sensing studies were devoted to solving two problems: (1) determining the physical difference between Cayley and Descartes geologic units near the landing site; and (2) determining the nature of the bright unit of Descartes mountain material. E.H.W.

N73-21788* Massachusetts Inst. of Tech., Cambridge. Haystack Observatory.
CALIBRATION OF RADAR DATA FROM APOLLO 16 RESULTS, PART X c07
S. H. Zisk and H. J. Moore (Geol. Surv.) *In* NASA. Lyndon B. Johnson Space Center Apollo 16 Prelim. Sci. Rept. 1972 3 p ref (For availability see N73-21729 12-30)
CSCL 17I

Predictions of surface and near surface blockiness using earth-based radar measurements were made. Two polarizations of the radar echoes were measured– polarized and depolarized. Particular attention was given to the depolarized echoes. North Ray and South Ray Craters and a 512-m diameter lunar crater in the Flamsteed Ring were used for the study. E.H.W.

N73-21789* Geological Survey, Washington, D.C.
PHYSICAL AND GEOLOGICAL ASPECTS OF HEILIGENSCHEIN MEASUREMENTS, PART Y c23
Robert L. Wildey *In* NASA. Lyndon B. Johnson Space Center Apollo 16 Prelim. Sci. Rept. 1972 7 p refs (For availability see N73-21729 12-30)
CSCL 20F

A preliminary attempt was made to evaluate the geological significance of the dispersion in the heiligenschein index. Heiligenschein coordinates were plotted on the 1:5,000,000 geologic map of the near side of the moon. The purpose was to evaluate the specific geologic unit involved in the case of each heiligenschein display. Tentative results that list the mean heiligenschein index and the rms deviation for each geologic map unit are given. Author

N73-21790* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
PHOTOGRAMMETRY AND ALTIMETRY. PART A: APOLLO 16 LASER ALTIMETER c14
W. R. Wollenhaupt and W. L. Sjogren (JPL) *In its* Apollo 16 Prelim. Sci. Rept. 1972 5 p (For availability see N73-21729 12-30)
CSCL 14B

The laser altimeter measures precise altitudes of the command and service module above the lunar surface and can function either with the metric (mapping) camera or independently. In the camera mode, the laser altimeter ranges at each exposure time, which varies between 20 and 28 sec (i.e., 30 to 43 km on the lunar surface). In the independent mode, the laser altimeter

ranges every 20 sec. These altitude data and the spacecraft attitudes that are derived from simultaneous stellar photography are used to constrain the photogrammetric reduction of the lunar surface photographs when cartographic products are generated. In addition, the altimeter measurements alone provide broad-scale topographic relief around the entire circumference of the moon. These data are useful in investigating the selenodetic figure of the moon and may provide information regarding gravitational anomalies on the lunar far side. Author

N73-21791* Geological Survey, Washington, D.C.
PHOTOGRAMMETRY USING APOLLO 16 ORBITAL PHOTOGRAPHY, PART B c14
Sherman S. C. Wu, Francis J. Schafer, Raymond Jordan, and Gary M. Nakata *In* NASA. Lyndon B. Johnson Space Center Apollo 16 Prelim. Sci. Rept. 1972 5 p (For availability see N73-21729 12-30)
CSCL 14E

Discussion is made of the Apollo 15 and 16 metric and panoramic cameras which provided photographs for accurate topographic portrayal of the lunar surface using photogrammetric methods. Nine stereoscopic models of Apollo 16 metric photographs and three models of panoramic photographs were evaluated photogrammetrically in support of the Apollo 16 geologic investigations. Four of the models were used to collect profile data for crater morphology studies; three models were used to collect evaluation data for the frequency distributions of lunar slopes; one model was used to prepare a map of the Apollo 16 traverse area; and one model was used to determine elevations of the Cayley Formation. The remaining three models were used to test photogrammetric techniques using oblique metric and panoramic camera photographs. Two preliminary contour maps were compiled and a high-oblique metric photograph was rectified. Author

N73-21792* Geological Survey, Washington, D.C.
FREQUENCY DISTRIBUTIONS OF LUNAR SLOPES, PART C
Sherman S. C. Wu and H. J. Moore *In* NASA. Lyndon B. Johnson Space Center Apollo 16 Prelim. Sci. Rept. 1972 6 p refs (For availability see N73-21729 12-30)
CSCL 03C

The metric and panoramic cameras aboard the Apollo 16 spacecraft provided photographs on which photogrammetric techniques may be used to obtain precise measurements of horizontal distances and elevations. It is reported that these measurements may in turn be used to obtain slope-frequency distributions of lunar surfaces at various slope lengths and for various types of terrain and geologic map units. Bistatic radar and photoclinometric methods were also used to obtain the same data. Author

N73-21793* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
ASTRONOMICAL PHOTOGRAPHY, PART A: GUM NEBULA, GALACTIC CLUSTER, AND ZODIACAL LIGHT PHOTOGRAPHY c14
R. D. Mercer (Dudley Obs.), L. Dunkelman, and Thomas K. Mattingly *In its* Apollo 16 Prelim. Sci. Rept. 1972 2 p (For availability see N73-21729 12-30)
CSCL 14E

It is reported that the Apollo 16 command module astronomical photography was performed with the specific objective of capitalizing on the uniqueness of the double umbra as a vantage point to collect astronomical data that are obtainable only near our Moon. For this reason, these data will be compared directly to analogous photography performed from Earth orbit during Project Mercury and the Gemini Program as well as to the Apollo-duplicated photography taken from sites on the Earth surface. Comparison with Earth-based photography should yield direct information on the Earth airglow layer and on atmospheric scattering and extinction. Author

N73-21794* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
SOLAR CORONA PHOTOGRAPHY, PART B c14
R. M. MacQueen (High Altitude Obs.), C. L. Ross (High Altitude Obs.), and Thomas K. Mattingly *In its* Apollo 16 Prelim. Sci. Rept. 1972 2 p refs (For availability see N73-21729 12-30)
CSCL 14E

Photographic observations of the solar corona by the Apollo 16 command module pilot while in lunar orbit are reported. These were designed to provide data on outer coronal forms and intensities to elongation angles of 25 deg. The results of Apollo 15 solar corona photography verified the procedures and provided the first photographs of identifiable coronal streamers curving at elongation angles of some 10 deg. By using the Apollo 15 data, exposure settings were optimized for Apollo 16, and the results show a significant improvement in photometric quality over the large range of brightness to be photographed. Ground observations of the inner solar corona (to approximately 2 solar radii from Sun center) indicate a general lack of coronal structure, and results of data reduction thus far show no streamer structure at large elongation angles. Author

N73-21795*# Scientific Translation Service, Santa Barbara, Calif.
PROBLEMS OF LUNAR GEOLOGY
A. V. Peyve, ed. Washington NASA Jan. 1973 455 p refs Transl. into ENGLISH of the book "Problemy Geologii Luny" Moscow, Nauka Press, 1969 p 1-285
(Contract NASw-2035)
(NASA-TT-F-689) Avail: NTIS HC $6.00 CSCL 03B

Articles devoted to the study of the geological structure of the moon based on the extensive data furnished by telescopic photographs and pictures taken by automatic space stations and satellites are presented. For individual titles, see N73-21796 through N73-21810.

N73-21796* Scientific Translation Service, Santa Barbara, Calif.
PROBLEMS OF LUNAR GEOLOGY: INTRODUCTION
M. S. Markov *In its* Probl. of Lunar Geol. Jan. 1973 p 1-7 (For availability see N73-21795 12-30)
CSCL 03B

Problems which could be solved in a comparative geological study of the planets of the solar system are discussed along with the methodology of geological-morphological analysis of the lunar surface. F.O.S.

N73-21797* Scientific Translation Service, Santa Barbara, Calif.
TECHNIQUE OF MAPPING AND A LEGEND FOR GEOLOGICAL-MORPHOLOGICAL MAPS OF THE MOON ON A SCALE OF 1:1,000,000 c13
A. L. Sukhanov and V. G. Trifonov *In its* Probl. of Lunar Geol. Jan. 1973 p 8-42 refs (For availability see N73-21795 12-30)
CSCL 08B

A methodology is developed for interpreting telescopic and other pictures of the lunar surface for the purpose of indicating rock complexes and structures of various ages on geological-morphological rocks of the moon. The classification of lunar craters and other features according to age is discussed, as well as morphological signs. Author

N73-21798* Scientific Translation Service, Santa Barbara, Calif.
THE THICKNESS OF THE PROCELLARUM COMPLEX
A. L. Sukhanov and L. M. Shkerin *In its* Probl. of Lunar Geol. Jan. 1973 p 43-53 refs (For availability see N73-21795 12-30)
CSCL 03B

Lunar crater models of various authors are discussed. These include young, unfilled craters, and craters filled with material from various periods in the moon's development. Curves between crater depths and crater diameter are developed. Author

N73-21799* Scientific Translation Service, Santa Barbara, Calif.
EXPLANATORY NOTES FOR THE GEOLOGICAL-MORPHOLOGICAL CHARTS OF THE SOUTHERN PART OF MARE IMBRIUM, THE CRATER COPERNICUS AND ITS VICINITY (SHEETS LAC-40, 58)
P. V. Florenskiy *In its* Probl. of Lunar Geol. Jan. 1973 p 54-71 refs (For availability see N73-21795 12-30)
CSCL 03B

The charts for this region are discussed on the basis of observations made by lunar orbiter spacecraft and others. The historical development of this chart is traced back to 1893. Author

N73-21800* Scientific Translation Service, Santa Barbara, Calif.
EXPLANATORY NOTES FOR THE GEOLOGICAL-MORPHOLOGICAL CHART OF THE NORTHERN PART OF MARE NUBIUM (SHEET LAC-76)
M. S. Markov *In its* Probl. of Lunar Geol. Jan. 1973 p 72-92 refs (For availability see N73-21795 12-30)
CSCL 03B

A general discussion is given of the lunar features and geology within this region. The historical development of these charts is traced. Data from the Ranger spacecraft are described. Author

N73-21801* Scientific Translation Service, Santa Barbara, Calif.
EXPLANATORY NOTES FOR THE GEOLOGICAL-MORPHOLOGICAL CHARTS OF THE REGION OF THE CIRQUES THEOPHILUS AND PTOLEMAEUS (SHEETS LAC-77, 78)
A. L. Sukhanov *In its* Probl. of Lunar Geol. Jan. 1973 p 93-120 refs (For availability see N73-21795 12-30)
CSCL 03B

The geological and physical features within this region are discussed. A historical perspective of these charts is given. Author

N73-21802* Scientific Translation Service, Santa Barbara, Calif.
EXPLANATORY NOTES FOR THE GEOLOGICAL-MORPHOLOGICAL CHARTS FOR THE REGION OF THE CRATER ARCHIMEDES AND THE APENNINE AND HAEMUS MOUNTAINS (SHEETS LAC-41, 59, 60)
V. G. Trifonov *In its* Probl. of Lunar Geol. Jan. 1973 p 121-201 refs (For availability see N73-21795 12-30)
CSCL 03B

The geology and physical properties of features within the region are discussed. The history of this region is traced back to 1896. Author

N73-21803* Scientific Translation Service, Santa Barbara, Calif.
ANCIENT SEAS OF THE MOON
A. L. Sukhanov *In its* Probl. of Lunar Geol. Jan. 1973 p 203-227 refs (For availability see N73-21795 12-30)
CSCL 03B

Research on lunar maria performed by American and Russian scientists is discussed. The discussion begins with the analysis of J. E. Spurr in 1944. Author

N73-21804* Scientific Translation Service, Santa Barbara, Calif.
FEATURES OF LAVA-SHEET FORMATION ON THE MOON
A. M. Gutkin, Ts. M. Raytburd, M. V. Slonimskaya, N. G. Sushkin, and I. A. Fomina *In its* Probl. of Lunar Geol. Jan. 1973 p 228-265 refs (For availability see N73-21795 12-30)
CSCL 03B

Observations of volcanic activity on the moon are discussed. The heat losses experienced by the lava due to radiation, convection and other processes are analyzed. Other problems analyzed include hardening of the lava, bubble rising in the melt, and other physical phenomena. Author

N73-21805* Scientific Translation Service, Santa Barbara, Calif.
SOME FEATURES OF THE SMALL CRATERS OF THE MOON
A. L. Sukhanov *In its* Probl. of Lunar Geol. Jan. 1973 p 267-289 refs (For availability see N73-21795 12-30)
CSCL 03B

Craterlets, which are craters on the order of a few kilometers, are considered to be of single-impact origin, and therefore have features which are distinctly different from those of large craters on the moon. Research by American and Russian scientists on the topic is discussed. Author

N73-21806* Scientific Translation Service, Santa Barbara, Calif.
UNEVEN DISTRIBUTION OF ANNULAR STRUCTURES ON THE MOON ON THE BASIS OF THEIR DIAMETER
P. V. Florenskiy, Ye. I. Zabelin, S. V. Mochalov, and Yu. G. Pimenov *In its* Probl. of Lunar Geol. Jan. 1973 p 290-321 refs (For availability see N73-21795 12-30)
CSCL 03B

The irregular size frequency-distribution of ring structures on the moon is discussed. A history of the problem of the distribution of the number of craters as a function of their diameter is given. Data obtained from the Luna-9 and Ranger-7 spacecrafts are described. Author

N73-21807* Scientific Translation Service, Santa Barbara, Calif.
COMPARISON OF FORMS OF LUNAR RELIEF WITH TERRESTRIAL VOLCANIC FORMATIONS
V. G. Trifonov *In its* Probl. of Lunar Geol. Jan. 1973 p 322-344 refs (For availability see N73-21795 12-30)
CSCL 03B

Recent evidence shows that the terrain features of the moon are due both to cosmic and endogenic processes. Those features of the moon are classified according to their origin. This is also done for several volcanic features on the Earth. Author

N73-21808* Scientific Translation Service, Santa Barbara, Calif.
VOLCANIC RIDGES ON THE MOON
A. L. Sukhanov *In its* Probl. of Lunar Geol. Jan. 1973 p 345-371 refs (For availability see N73-21795 12-30)
CSCL 03B

Volcanic ridges on the moon are classified according to their origin, geometrical shape and size. Author

N73-21809* Scientific Translation Service, Santa Barbara, Calif.
SOME GENERAL FEATURES OF THE DEVELOPMENT OF STRUCTURES ON THE MOON AND DETAILS OF ITS GEOLOGICAL HISTORY
M. S. Markov and A. L. Sukhanov *In its* Probl. of Lunar Geol. Jan. 1973 p 372-389 refs (For availability see N73-21795 12-30)
CSCL 03B

The processes leading to the formation of various lunar features are identified. The development of the large scale features (continents and maria) on the moon are discussed. Author

N73-21810* Scientific Translation Service, Santa Barbara, Calif.
GEOLOGICAL COMPARISON OF THE MOON AND EARTH
V. G. Trifonov and P. V. Florenskiy *In its* Probl. of Lunar Geol. Jan. 1973 p 390-410 refs (For availability see N73-21795 12-30)
CSCL 03C

The geological processes leading to the layering on the moon are discussed and compared with processes on the earth. Research conducted by various Russian and American scientists on volcanic activity is described. Author

N73-21811*# Stanford Univ., Calif. Inst. for Plasma Research.
SOME ASPECTS OF COSMIC SYNCHROTRON SOURCES Interim Report
Richard I. Epstein Mar. 1973 74 p refs
(Grant NGL-05-020-272; Contract N00014-67-A-0112-0062; Grant NSF GP-23840)
(NASA-CR-131526; SUIPR-435) Avail: NTIS HC $5.75 CSCL 03A

Synchrotron emission is considered from individual particles which have small pitch angles and the general properties of synchrotron sources which mainly contain such particles, as well as the emissivities and degrees of circular polarization for specific source distributions. The limitation of synchrotron source models for optical pulsars and compact extragalactic objects are discussed, and it is shown that several existing models for the pulsar NP 0532 are inconsistent with the measured time variations and polarizations of the optical emission. Discussion is made also of whether the low frequency falloffs in the extragalactic objects PKS 2134 + 004, OQ 208, and NGC 1068 are due to emission from particles with small pitch angles or absorption by a thermal plasma or synchrotron self-absorption. It is concluded that the absorption interpretations cannot account for the turnover in the spectrum of PKS 2134 + 004. Measurements of polarization, angular structure, and X-ray flux are also described. Author

N73-21812*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
STRUCTURAL LOAD REDUCTION OF THE SPACE SHUTTLE BOOSTER/ORBITER CONFIGURATION USING A LOAD RELIEF GUIDANCE TECHNIQUE
A. W. Deaton and P. B. Kelley 5 Apr. 1973 34 p refs
(NASA-TM-X-64738) Avail: NTIS HC $3.75 CSCL 22A

A space shuttle booster/orbiter atmospheric ascent guidance algorithm is developed that will reduce the aerodynamically induced structural loads as compared to an open loop guidance algorithm. Author

N73-21813*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
LOW-THRUST MISSION RISK ANALYSIS, WITH APPLICATION TO A 1980 RENDEZVOUS WITH THE COMET ENCKE
C. L. Yen and D. B. Smith 15 Mar. 1973 35 p refs
(Contract NAS7-100)
(NASA-CR-131518; JPL-TM-33-593) Avail: NTIS HC $3.75 CSCL 22A

A computerized failure process simulation procedure is used to evaluate the risk in a solar electric space mission. The procedure uses currently available thrust-subsystem reliability data and performs approximate simulations of the thrust subsystem burn operation, the system failure processes, and the retargeting operations. The method is applied to assess the risks in carrying out a 1980 rendezvous mission to the comet Encke. Analysis of the results and evaluation of the effects of various risk factors on the mission show that system component failure rates are the limiting factors in attaining a high mission reliability. It is also shown that a well-designed trajectory and system operation mode can be used effectively to partially compensate for unreliable thruster performance. Author

N73-21814*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ANALYTIC EXPRESSIONS FOR PERTURBATIONS AND PARTIAL DERIVATIVES OF RANGE AND RANGE RATE OF A SPACECRAFT WITH RESPECT TO THE COEFFICIENT OF THE SECOND HARMONIC
R. M. Georgevic 15 Mar. 1973 59 p refs
(Contract NAS7-100)
(JPL-TM-33-594) Avail: NTIS HC $5.00 CSCL 22A

Closed-form analytic expressions for the time variations of instantaneous orbital parameters and of the topocentric range and range rate of a spacecraft moving in the gravitational field of an oblate large body are derived using a first-order variation of parameters technique. In addition, the closed-form analytic expressions for the partial derivatives of the topocentric range and range rate are obtained, with respect to the coefficient of the second harmonic of the potential of the central body (J sub 2). The results are applied to the motion of a point-mass spacecraft moving in the orbit around the equatorially elliptic, oblate sun, with J sub 2 approximately equal to .000027. Author

N73-21815*# Northrop Services, Inc., Huntsville, Ala.
ROCKET ASCENT G-LIMITED MOMENT-BALANCED OPTIMIZATION PROGRAM (RAGMOP) Final Report
J. T. Lyons, W. S. Woltosz, G. E. Abercrombie, and R. G. Gottlieb Aug. 1972 266 p refs
(Contract NAS8-27621)
(NASA-CR-129000; TR-243-1078) Avail: NTIS HC $15.50 CSCL 22C

This document describes the RAGMOP (Rocket Ascent G-limited Moment-balanced Optimization Program) computer program for parametric ascent trajectory optimization. RAGMOP computes optimum polynomial-form attitude control histories, launch azimuth, engine burn-time, and gross liftoff weight for space shuttle type vehicles using a search-accelerated, gradient projection parameter optimization technique. The trajectory model available in RAGMOP includes a rotating oblate earth model, the option of input wind tables, discrete and/or continuous throttling for the purposes of limiting the thrust acceleration and/or the maximum dynamic pressure, limitation of the structural load indicators (the product of dynamic pressure with angle-of-attack and sideslip angle), and a wide selection of intermediate and terminal equality constraints. Author

N73-21816*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A QUALITATIVE STUDY OF THE COMPLETE SET OF SOLUTIONS OF THE DIFFERENTIAL EQUATION OF MOTION OF A TEST PARTICLE IN THE EQUATORIAL PLANE OF THE KERR GRAVITATIONAL FIELD
Harry E. Montgomery and F. K. Chan Washington Mar. 1973 201 p refs
(NASA-TR-R-403; G-1071) Avail: NTIS HC $3.00 CSCL 08N

A study is made of the mathematical solution of the differential equation of motion of a test particle in the equatorial plane of the Kerr gravitational field, using S (Schwarzschild-like) coordinates. A qualitative solution of this equation leads to the conclusion that there can only be 25 different types of orbits. For each value of a, the results are presented in a master diagram for which h and e are the parameters. A master diagram divides the h, e parameter space into regions such that at each point within one of these regions the types of admissible orbits are qualitatively the same. A pictorial representation of the physical orbits in the r, phi plane is also given. Author

N73-21817# Joint Publications Research Service, Arlington, Va.
SOVIET-BLOC RESEARCH IN GEOPHYSICS, ASTRONOMY, AND SPACE, NO. 298
13 Apr. 1973 59 p refs Transl. into ENGLISH from the Russian
(JPRS-58734) Avail: NTIS HC $5.00

Translations and abstracts of articles on meteorology, oceanography, upper atmosphere and space research, astronomy and terrestrial geophysics, covering both science news and formal scientific reports. Published details of Soviet space spectaculars are included. Author

N73-21818*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MARTIAN TIDAL PRESSURE AND WIND FIELDS OBTAINED FROM THE MARINER 9 INFRARED SPECTROSCOPY EXPERIMENT
Joseph A. Pirraglia and Barney J. Conrath Mar. 1973 51 p refs
(NASA-TM-X-66230; X-620-73-82) Avail: NTIS HC $4.75 CSCL 03B

Using temperature fields derived from the Mariner 9 infrared spectroscopy experiment, the Martian atmospheric tidal pressure and wind fields are calculated. Temperature as a function of local time, latitude, and atmospheric pressure level is obtained by secular and longitudinal averaging of the data. The resulting temperature field is approximated by a spherical harmonic expansion, retaining one symmetric and one asymmetric term for wavenumber zero and wavenumber one. Vertical averaging of the linearized momentum and continuity equations results in an inhomogeneous tidal equation for surface pressure fluctuations with the driving function related to the temperature field through the geopotential function and the hydrostatic equation. Solutions of the tidal equation show a diurnal fractional pressure amplitude approximately equal to one half of the vertically averaged diurnal fractional temperature amplitude. Author

N73-21819# National Academy of Sciences-National Research Council, Washington, D.C. Astronomy Survey Committee.
ASTRONOMY AND ASTROPHYSICS FOR THE 1970'S, VOLUME 1
Apr. 1972 150 p
(PB-212965; LC-72-79131; ISBN-0-309-02029-8) Avail: NTIS MF $0.95; National Academy of Sciences, Printing and Publishing Office, 2101 Constitution Ave., N. W., Washington, D. C. 20418 HC $4.75 CSCL 03B

The report reviews the frontier research in both ground-based and space-based astronomy and ongoing support in all areas of astronomy. On the basis of a comprehensive review of the opportunities and requirements of the disciplines of astronomy, the report offers a coherent program for astronomy and astrophysics that spans the next decade and includes programs ranging from modest new ground-based instruments to the most sophisticated space experiments. Recommendations presented reflect the Committee's effort to establish priorities, weighing scientific promise, technological state of the art, availability of funding, and availability of skilled personnel. Author (GRA)

N73-21820# California Univ., Los Angeles. School of Engineering and Applied Science.
PROBLEMS IN ESTIMATION THEORY WITH APPLICATIONS TO ORBIT DETERMINATION Interim Report
David Walker Curkendall Sep. 1972 174 p refs
(Contract F04701-72-C-0273; Grant AF-AFOSR-2166-72; AF Proj. 9769)
(AD-755802; UCLA-ENG-7275; AFOSR-73-0268TR) Avail: NTIS CSCL 22/3

Several problems in estimation theory with current application

interest to orbit determination are treated in the report. Although much of the material covered has general application, the important specific of interplanetary orbit determination is given special emphasis and is used throughout to provide context and to obtain numerical results. Topics covered include: modeling the errors in the navigation measurements, describing the navigation measurements compactly in terms of the unknown parameters, and describing the estimation accuracy in a variety of poorly modeled situations. Author (GRA)

N73-21821# Aerospace Corp., El Segundo, Calif. Lab. Operations.
INFRARED STARS WITH STRONG 1665-1667-mHz OH MICROWAVE EMISSION Report for Jun. 1969 - Sep. 1971
William J. Wilson 30 Nov. 1972 43 p refs
(Contract F04701-72-C-0073)
(AD-753898; TR-0073(9230-30)-1; SAMSO-TR-72-290) Avail: NTIS CSCL 03/2

Microwave and infrared observations are presented of seven stars that have strong infrared and 1665/1667-mHz main-line OH emission. The sources were selected because the 1665/1667-mHz OH emission is stronger than the 1612-mHz OH emission. Five of these sources have associated H2O microwave emission. The sources are associated with M-type, long-period variable stars and generally show only a small, excess infrared radiation from 3 to 20 micrometers above that expected from the photosphere. The data indicate that both 1665/1667-mHz and 1612-mHz stars form a continuous sequence in their intrinsic OH luminosities and their infrared properties. Author (GRA)

N73-21822# Owens Valley Radio Observatory, Pasadena, Calif.
A HIGH RESOLUTION NEUTRAL HYDROGEN STUDY OF THE GALAXY M 51
L. Weliachew and S. T. Gottesman 1972 35 p refs
(Contract N00014-67-A-0094-0019)
(AD-754078; Rept-1972-13) Avail: NTIS CSCL 03/2

A 2 arc min synthesis study of the spiral galaxy M51 (NGC 5194) has been made in the lambda 21 cm emission line of neutral hydrogen. A morphological HI symmetry axis is found at a position angle of 22 degrees while the dynamically determined major axis is found at a position angle of -8 degrees. The velocities in the north-east outer spiral structure are found to be strongly noncircular. They agree in magnitude with predictions made by Toomre and Toomre for the tidal interaction between M51 and its companion galaxy NGC 5195. A possible continuation in neutral hydrogen of the outermost south-west spiral arm has been detected. M51 also exhibits a strong deficiency in HI surface density at its center. An upper limit of 10 billion solar mass units per beam area has been placed on the neutral hydrogen content of the companion galaxy NGC 5195. This, in turn, yields an upper limit of about 0.1 for the distance-independent ratio M(HI)/L(pg). Author (GRA)

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also; 28 Propulsion Systems; and 32 Structural Mechanics.

N73-21823*# Ohio State Univ. Research Foundation, Columbus.
FREE ADJUSTMENT OF A GEOMETRIC GLOBAL SATELLITE NETWORK (SOLUTION MPS-7)
Ivan I. Mueller and Marvin C. Whiting Oct. 1972 34 p refs
(Grant NGR-36-008-093; OSURF Proj. 2514)
(NASA-CR-131535; Rept-188) Avail: NTIS HC $3.75 CSCL 03B

The basic purpose of this experiment was to compute reduced normal equations from the observational data of several different systems described below to combine them eventually with the normal equations of the Wild BC-4 observations taken in the DOD/DOC cooperative worldwide geodetic satellite program and provide station coordinates from a single least squares adjustment. The solution described is a partial one obtained without the use of the BC-4 data. The observational systems combined were the Baker-Nunn simultaneous camera from the SAO worldwide network, the MOTS and PC-1000 optical observations in North America, miscellaneous camera observations in Europe which were included in the SAO69 solution, and, lastly, a group of optical observations where Baker-Nunn cameras observed simultaneously with MOTS and/or PC-1000 cameras in the previously mentioned group. Author

N73-21824*# Honeywell, Inc., Minneapolis, Minn. Systems and Research Div.
CONTROL OF A FLEXIBLE SPACE SHUTTLE VEHICLE Final Report
C. A. Harvey Feb. 1973 132 p refs
(Contract NAS8-25708)
(NASA-CR-124183; Rept-12238-FR) Avail: NTIS HC $8.75 CSCL 22B

The application of optimal control technology to the design of a controller for the space shuttle descent was studied using weighting matrices adjusted through iteration to reduce response peaks, which are defined as mean magnitude plus sigma values. The synthesis techniques and optimal controller design are discussed along with simplified controller design. Quantitative characteristics of the optimal controller, effects of variation of sample rate, and simplified controller data are included. F.O.S.

N73-21825*# Rensselaer Polytechnic Inst., Troy, N.Y. School of Engineering.
ANALYSIS AND DESIGN OF A CAPSULE LANDING SYSTEM AND SURFACE VEHICLE CONTROL SYSTEM FOR MARS EXPLORATION Progress Report, 1 Jul. - 31 Dec. 1972
D. K. Frederick, P. K. Lashmet, G. N. Sandor, C. N. Shen, E. J. Smith, and S. W. Yerazunis 31 Dec. 1972 110 p refs
(Grant NGL-33-018-091)
(NASA-CR-131515; RPI-TR-MP-30) Avail: NTIS HC $7.50 CSCL 22B

Investigation of problems related to the design and control of a mobile planetary vehicle to implement a systematic plan for the exploration of Mars has been undertaken. Problem areas receiving attention include: vehicle configuration, control, dynamics, systems and propulsion; systems analysis; terrain modeling and path selection; and chemical analysis of specimens. The following specific tasks have been under study: vehicle model design, mathematical modeling of a dynamic vehicle, experimental vehicle dynamics, obstacle negotiation, electro-mechanical controls, collapsibility and deployment, construction of a wheel tester, wheel analysis, payload design, system design optimization, effect of design assumptions, accessory optimal design, on-board computer subsystem, laser range measurement, discrete obstacle detection, obstacle detection systems, terrain modeling, path selection system simulation and evaluation, gas chromatograph/mass spectrometer system concepts, chromatograph model evaluation and improvement. Author

N73-21826*# Pennsylvania State Univ., University Park. Dept. of Aerospace Engineering.
INVESTIGATION OF TECHNICAL PROBLEMS RELATED TO DEPLOYMENT AND RETRIEVAL OF SPINNING SATELLITES Summary Final Report, 1 Jan. 1970 - 31 Dec. 1972
Marshall H. Kaplan Apr. 1973 26 p refs
(Grant NGR-39-009-162)
(NASA-CR-131510) Avail: NTIS HC $3.50 CSCL 22A

Results of a three-year research effort on retrieval and deployment problems associated with orbiting payloads are summarized. Answers to several basic questions about rendezvous, docking, and deployment dynamics and controls were obtained. A basic retrieval mission profile was formulated in order to develop relevant technology. A remotely controlled retrieval package was conceived. Special deployment dynamics problems associated with high altitude deployment were investigated, and new knowledge of payload spin reorientation was obtained. Author

N73-21827*# Southwest Research Inst., San Antonio, Tex.
PREDICTION OF SHUTTLE VEHICLE DAMPING FROM COMPONENT TEST RESULTS Final Report
Daniel D. Kana Mar. 1973 52 p refs

(Contract NAS8-27569)
Avail: NTIS HC $4.75 CSCL 22B

A dissipative energy approach for predicting the damping of four-component space shuttle model by means of modal parameters obtained from tests of the individual components is presented. A relationship between modal damping energy per cycle and peak strain (or kinetic) energy is first determined empirically from test data for each component. Undamped analytical models of each component are also developed, and combined into a system model from which are obtained modal kinetic (or strain) energies for its respective modes. These data are then used with the empirical damping curves to apportion the proper amount of damping energy to each component in a combined system mode, and thereby allow a prediction of damping ratio. Some discrepancies in results are noted to occur because of incomplete modeling of connecting link mechanisms and anomalies in modal responses. Author

N73-21828*# Applied Dynamics Research Corp., Huntsville, Ala.
INVESTIGATION OF EMPIRICAL DAMPING LAWS FOR THE SPACE SHUTTLE Final Report
Edward L. Bernstein 14 Mar. 1973 95 p refs
(Contract NAS8-28513)
(NASA-CR-124203; T1044F) Avail: NTIS HC $6.75 CSCL 22B

An analysis of dynamic test data from vibration testing of a number of aerospace vehicles was made to develop an empirical structural damping law. A systematic attempt was made to fit dissipated energy/cycle to combinations of all dynamic variables. The best-fit laws for bending, torsion, and longitudinal motion are given, with error bounds. A discussion and estimate are made of error sources. Programs are developed for predicting equivalent linear structural damping coefficients and finding the response of nonlinearly damped structures. Author

N73-21929*# Chrysler Corp., New Orleans, La. Data Management Services.
RESULTS OF INVESTIGATIONS ON A 0.0405 SCALE MODEL PRR VERSION OF THE NR-SSV ORBITER IN THE NORTH AMERICAN AERONAUTICAL LABORATORY LOW SPEED WIND TUNNEL
R. B. Kingsland (North Am. Rockwell Corp., Los Angeles, Calif.), J. E. Vaughn, and R. Singellton Mar. 1973 370 p
(Contract NAS9-13247)
(NASA-CR-123851; DMS-DR-2017) Avail: NTIS HC $20.50 CSCL 22B

Experimental aerodynamic investigations were conducted in a low speed wind tunnel on a scale model space shuttle vehicle (SSV) orbiter. The purpose of the test was to investigate the longitudinal and lateral-directional aerodynamic characteristics of the space shuttle orbiter. Emphasis was placed on model component, wing-glove, and wing-body fairing effects, as well as elevon, aileron, and rudder control effectiveness. Angles of attack from - 5 deg to + 30 deg and angles of sideslip of - 5 deg, 0 deg, and + 5 deg were tested. Static pressures were recorded on base, fuselage, and wing surfaces. Tufts and talc-kerosene flow visualization techniques were also utilized. The aerodynamic force balance results are presented in plotted and tabular form. Author

N73-21830*# Lockheed Missiles and Space Co., Huntsville, Ala. Research and Engineering Center.
HEAT TRANSFER TESTS OF THE NASA-MSC SPACE SHUTTLE CONFIGURATION AT THE LANGLEY RESEARCH CENTER MACH 8 VARIABLE DENSITY FACILITY Final Report
L. E. Connor, V. W. Sparks, and A. G. Bhadsavle Feb. 1971 103 p refs
(Contract NAS9-10506)
(NASA-CR-128891; LMSC/HREC-D162761; HREC-0506-1) Avail: NTIS HC $7.25 CSCL 22B

The experimental investigations performed on the NASA-Manned Spacecraft Center Space Shuttle orbiter and booster configurations at a Mach 8 variable density facility are presented. The test program was a series of aerothermodynamic wind tunnel tests that were run over a range of angles of attack, yaw angles, and Reynolds numbers. Objectives of the test program were to obtain heat transfer data over the NASA-Manned Spacecraft Center Space Shuttle orbiter, booster, and launch configurations for a range of angles of attack from - 20 to + 30 deg, yaw angles of 0 and + or - 6 deg, and Reynolds numbers of 0.6, 2.0, and 3.7 x one million. The phase-change coating technique was used to obtain heat transfer data. Information received from these tests will be instrumental in performing thermal protection systems studies and vehicle aerodynamic design. Author

N73-21831*# Chrysler Corp., New Orleans, La. Data Management Services.
SPACE SHUTTLE (ATP CONFIGURATION) ABORT STAGING INVESTIGATION
J. Rampy, K. Blackwell, E. Allen, and I. Fossler Apr. 1973 200 p
(Contract NAS9-13247)
(NASA-CR-120089; DMS-DR-2011) Avail: NTIS HC $12.00 CSCL 22B

A wind tunnel test conducted in a 14-inch trisonic wind tunnel to determine the force and moment characteristics of the ATP Orbiter and modified ATP External Tank/SRB combination during abort staging conditions is discussed. Six component aerodynamic force and moment data were recorded for the orbiter and ET/SRB combination. Pitch polars were obtained for an angle of attack range from minus 10 to plus 10 degrees and orbiter incidence angles (orbiter relative to the ET/SRB combination) of 0 and 2 degrees. A limited amount of yaw data were obtained at 0 degree angle of attack and beta range from minus 10 to plus 10 degrees. In addition, orbiter pitch control effectiveness was determined at several grid points. These force and moment data were obtained for Mach numbers of 0.9, 1.2 and 2.0. Author

N73-21832*# Chrysler Corp., New Orleans, La. Data Management Services.
RESULTS OF INVESTIGATIONS ON A 0.0405 SCALE MODEL ATP VERSION OF THE NR-SSV ORBITER IN THE NORTH AMERICAN AERONAUTICAL LABORATORY LOW SPEED WIND TUNNEL
Robert Mennell (North Am. Rockwell Corp.), J. E. Vaughn, and R. Singellton Mar. 1973 403 p
(Contract NAS9-13247)
(NASA-CR-120092; DMS-DR-2016) Avail: NTIS HC $22.25 CSCL 22B

Experimental aerodynamic investigations were conducted on a scale model space shuttle vehicle (SSV) orbiter. The purpose of the test was to investigate the longitudinal and lateral-directional aerodynamic characteristics. Emphasis was placed on model component, wing-glove, and wing-body fairing effects, as well as elevon, aileron, and rudder control effectiveness. Angles of attack from - 5 deg to + 30 deg and angles of sideslip from - 5 deg to + 10 deg were tested. Static pressures were recorded on base, fuselage, and wing surfaces. Tufts and talc-kerosene flow visualization techniques were also utilized. The aerodynamic force balance results are presented in plotted and tabular form. Author

N73-21833# Aerospace Corp., Washington, D.C.
ANALYSIS OF AN AERONAUTICAL SATELLITE EVALUATION AND DEVELOPMENT SYSTEM
Emerson, Nakamura, Kleinbauer, Scardina (MITRE Corp.), and Carr (FAA) FAA Jan. 1973 48 p
(Contract DOT-FA71WA-2577)
(FAA-RD-73-41; Rept-73-4) Avail: NTIS HC $4.50

The background for an evaluation and development aeronautical satellite is presented. A set of operational use concepts to be tested is developed. Various practical combinations of voice communications, data link communications, automatic position reporting, and ground-based surveillance are outlined. With these are associated the access methods of direct seizing of available channels by users, request by users for central control to assign them a channel, and polling of users by central control. Various modes of dedicating or sharing various numbers of channels among sectors, OCCs, and earth terminals are proposed. Return channels in excess of forward channels are considered. Various modes of ground data management are proposed. Experimentation requirements are outlined to gather engineering data for

propagation characteristics, modulation schemes, new equipment, and surveillance accuracy. Author

N73-21834*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
STRUCTURAL CONTROL INTERACTION
Robert S. Ryan, D. K. Mowery, S. W. Winder, and Halsey E. Worley 15 Jan. 1973 56 p
(NASA-TM-X-64732) Avail: NTIS HC $5.00 CSCL 22B

The basic guidance and control concepts that lead to structural control interaction and structural dynamic loads are identified. Space vehicle ascent flight load sources and the load relieving mechanism are discussed, along with the the characteristics and special problems of both present and future space vehicles including launch vehicles, orbiting vehicles, and the Space Shuttle flyback vehicle. The special dynamics and control analyses and test problems apparent at this time are summarized. Author

N73-21835*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MARINER MARS 1971 ATTITUDE CONTROL SUBSYSTEM FLIGHT PERFORMANCE
L. Schumacher 15 Mar. 1973 70 p refs
(Contract NAS7-100)
(NASA-CR-131522; JPL-TM-33-600) Avail: NTIS HC $5.50 CSCL 22B

The flight performance of the Mariner 71 attitude control subsystem is discussed. Each phase of the mission is delineated and the attitude control subsystem is evaluated within the observed operational environment. Performance anomalies are introduced and discussed within the context of general performance. Problems such as the sun sensor interface incompatibility, gas valve leaks, and scan platform dynamic coupling effects are given analytical considerations. Author

N73-21836*# Linguistic Systems, Inc., Cambridge, Mass.
SYMPHONIE: THE FRANCO-GERMAN TELECOMMUNICATIONS SATELLITE
P. Madon Washington NASA Apr. 1973 20 p Transl. into ENGLISH of conf. paper "Le Satellite de Telecommun. Franco-Allemand: Symphonie" Presented at 23d Intern. Astronaut. Congr., Vienna, 8-15 Oct., 1972 15 p
(Contract NASw-2482)
(NASA-TT-F-14875) Avail: NTIS HC $3.00 CSCL 22B

The Franco-German telecommunications satellite, Symphonie, is described in terms of on-board equipment relating to reception and transmission capabilities, as well as maximum area of coverage. Details of structure, propulsion, and stabilization characteristics are also provided along with beam accuracy profiles. Electric power is supplied by a solar generator, with nickel-cadmium batteries being used during eclipses. Scheduling of the prototype and first and second models is also discussed. J.M.M.

N73-21837# Royal Observatory, Edinburgh (Scotland).
STOPWATCH OBSERVATIONS OF SATELLITES, MAY 1972
May 1972 21 p
(ROE-STS-126) Avail: NTIS HC $3.25

Stopwatch observations made at stations during May 1972 are listed in satellite launch order and in time order for each satellite. Various subtotals are given. Author

N73-21838*# Chrysler Corp., New Orleans, La. Space Div.
HYPERSONIC AERODYNAMIC CHARACTERISTICS OF NR-ATP ORBITER, ORBITER WITH EXTERNAL TANK, AND ASCENT CONFIGURATION
George C. Ashby, Jr. (NASA. Langley Res. Center) Mar. 1973 123 p refs
(Contract NAS9-13247)
(NASA-CR-128754; DMS-DR-2003) Avail: NTIS HC $8.25 CSCL 22B

A scale model of the North American Rockwell ATP Orbiter with and without the external tank has been tested in a 22-inch helium tunnel at Mach 20 and a Reynolds number based on model length, of 2.14 times one million. Longitudinal and lateral-directional data were determined for the orbiter alone while only longitudinal characteristics and elevon roll effectiveness were investigated for the orbiter/tank combination. Oil flow and electron beam flow visualization studies were conducted for the orbiter alone, orbiter with external tank and the ascent configuration. Author

N73-21839*# National Aeronautics and Space Administration, Washington, D.C.
STRUCTURAL INTERACTION WITH TRANSPORTATION AND HANDLING SYSTEMS Space Vehicle Design Criteria
Jan. 1973 41 p refs
(NASA-SP-8104) Avail: NTIS HC $3.00 CSCL 22B

Problems involved in the handling and transportation of finished space vehicles from the factory to the launch site are presented, in addition to recommendations for properly accounting for in space vehicle structural design, adverse interactions during transportation. Emphasis is given to the protection of vehicle structures against those environments and loads encountered during transportation (including temporary storage) which would exceed the levels that the vehicle can safely withstand. Current practices for verifying vehicle safety are appraised, and some of the capabilities and limitations of transportation and handling systems are summarized. Author

N73-21840# Lockheed Missiles and Space Co., Palo Alto, Calif.
THE AUTOMATIC STATION PROGNOZ STANDS WATCH
V. Agalakov [1972] 7 p Transl. into ENGLISH from the book "Sovremennye Dostizheniia Kosmonavtiki" Znanie, USSR, no. 12, 1972 p 35-43
Avail: NTIS HC $3.00; National Translations Center, John Crerar Library, Chicago, Ill. 60616

The nature of the atmospheric boundary layer is discussed in terms of recent discoveries made by earth satellites. Emphasis is placed on the missions of Prognoz and Prognoz-2 to study solar activity processes and their influence on the interplanetary medium and on the earth's magnetosphere. Specific mention is made of solar corpuscular, gamma, and X radiation, along with solar plasma fluxes and their interaction with magnetic fields in near-earth space. The highly elliptical orbits of the Prognoz satellites are reported to be especially effective in the examination of almost all parts of the earth's gas envelope. J.M.M.

N73-21841*# Oak Ridge National Lab., Tenn. Neutron Physics Div.
SHIELDING OF MANNED SPACE VEHICLES AGAINST PROTONS AND ALPHA PARTICLES
R. G. Alsmiller, Jr., R. T. Santoro, J. Barish, and H. C. Claiborne Nov. 1972 525 p refs
(NASA Order H-38280-A; NASA Order H-79272-A; Contract W-7405-eng-26)
(NASA-CR-131517; ORNL-RSIC-35) Avail: NTIS HC $28.25 CSCL 22B

The available information on the shielding of manned space vehicles against protons and alpha particles is summarized. The emphasis is placed on shielding against Van Allen belt protons and against solar-flare protons and alpha particles, but information on shielding against galactic cosmic rays is also presented. The approximation methods for use by nonexperts in the space shielding field are those that are standard in the space shielding literature. Author

N73-21842# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Abteilung Mechanik und Bewegungssimulation.
INVESTIGATION OF THE DYNAMIC CHARACTERISTICS OF THE DIAL SATELLITE AFTER SEPARATION OF THE LAST STAGE [UNTERSUCHUNG DES DYNAMISCHEN VERHALTENS DES SATELLITEN DIAL NACH ABTRENNEN VON DER LETZTEN RAKETENSTUFE]
Juergen Puls and Reinhold Stapf Aug. 1972 46 p refs In GERMAN; ENGLISH summary
(DLR-FB-72-74) Avail: NTIS HC $4.50; DFVLR, Porz, West Ger. 12.90 DM

The dynamic characteristics of the Dial satellite after separation from the last stage were investigated in order to discover the reasons for abrupt nutations and their good damping. A summary of the theory of nutation of rigid bodies is presented, and probable errors during separation are discussed. Onboard equipment which causes the damping is reviewed by analysis of telemetry data of the attitude measurement system. The

damping effects of electric batteries were determined experimentally. ESRO

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N73-21843 Massachusetts Univ., Amherst.
VIBRATIONS OF SHALLOW SPHERICAL SANDWICH SHELLS Ph.D. Thesis
Hai-Boh Wang 1972 117 p
Avail: Univ. Microfilms Order No. 72-19488

A study which considers the effects of thickness-shear deformation and rotatory inertia is presented for the vibration analysis of shallow spherical sandwich shells. A tenth order system of three uncoupled differential equations, which governs the antisymmetric dynamic deformations of a shallow spherical sandwich shell subjected to arbitrary time-dependent surface load, is derived. For free vibrations, separable solutions are obtained in terms of the Bessel functions. For forced vibrations, solutions are obtained in terms of the Duhamel integral by utilizing the normal mode theory. Numerical comparisons between theories are provided for free and forced vibrations. Dissert. Abstr.

N73-21844 National Lending Library for Science and Technology, Boston Spa (England).
THE MECHANICS OF RIGID BODIES. THE LIMIT EQUILIBRIUM OF MULTILAYERED REINFORCED AXIALLY-SYMMETRIC SHELLS
U. V. Nemirovsky Aug. 1972 15 p refs Transl. into ENGLISH from Mekh. Tverd. Tela (Moscow), v. 6, 1969 p 80-89
(NLL-DRIC-Trans-2854-(3623.66)) Avail: Natl. Lending Library, Boston Spa, Engl.: 2 NLL photocopy coupons

The limit equilibrium of axially symmetrical shells made from multilayered, structurally orthotropic and uniform materials was investigated. The equilibrium of an elementary pair (a reinforced and an isotropic layer) under biaxial tension-compression is discussed along with the rate of change of the curvature with axisymmetric bending in cylindrical shells. F.O.S.

N73-21845*# Hydronautics, Inc., Laurel, Md.
HIGH FREQUENCY FATIGUE TESTING OF UDIMET 700 AT 1400 F
Andrew F. Conn and S. Lee Rudy Jun. 1972 35 p refs
(Contract NAS3-14335)
(NASA-CR-120958; TR-7150-1) Avail: NTIS HC $3.75 CSCL 20K

An investigation pertaining to the development of life prediction methods for materials subjected to high temperature creep/fatigue conditions is presented. High frequency (13.4 kHz) fatigue data were measured at 1400 F on specimens of the nickel-based alloy Udimet 700. Tests were conducted on the virgin material, as well as on specimens which had received prior exposures to high temperature, fatigue, and creep. Author

N73-21846*# Boeing Co., Seattle, Wash. Aerospace Group.
STRESS CORROSION CRACKING AND FATIGUE CRACK GROWTH STUDIES PERTINENT TO SPACECRAFT AND BOOSTER PRESSURE VESSELS
L. R. Hall and R. W. Finger Dec. 1972 175 p refs
(Contract NAS3-12003)
(NASA-CR-120823; D180-15018-1) Avail: NTIS HC $10.75 CSCL 20K

This experimental program was divided into two parts. The first part evaluated stress corrosion cracking in 2219-T87 aluminum and 5Al-2.5Sn (ELI) titanium alloy plate and weld metal. Both uniform height double cantilever beam and surface flawed specimens were tested in environments normally encountered during the fabrication and operation of pressure vessels in spacecraft and booster systems. The second part studied compatibility of material-environment combinations suitable for high energy upper stage propulsion systems. Surface-flawed specimens having thicknesses representative of minimum gage fuel and oxidizer tanks were tested. Titanium alloys 5Al-2.5Sn (ELI), 6Al-4V annealed, and 6Al-4V STA were tested in both liquid and gaseous methane. Aluminum alloy 2219 in the T87 and T6E46 condition was tested in fluorine, a fluorine-oxygen mixture, and methane. Results were evaluated using modified linear elastic fracture mechanics parameters. Author

N73-21847*# Boeing Co., Seattle, Wash. Aerospace Group.
FRACTURE AND CRACK GROWTH RESISTANCE STUDIES OF 304 STAINLESS STEEL WELDMENTS RELATING TO RETESTING OF CRYOGENIC VESSELS
L. R. Hall and R. W. Finger Dec. 1972 58 p refs
(Contract NAS3-12003)
(NASA-CR-121025; D180-15220-1) Avail: NTIS HC $5.00 CSCL 20K

Fracture and crack growth resistance characteristics of 304 stainless steel alloy weldments as relating to retesting of cryogenic vessels were examined. Welding procedures were typical of those used in full scale vessel fabrication. Fracture resistance survey tests were conducted in room temperature air, liquid nitrogen and liquid hydrogen. In air, both surface-flawed and center-cracked panels containing cracks in weld metal, fusion line, heat-affected zone, or parent metal were tested. In liquid nitrogen and liquid hydrogen, tests were conducted using center-cracked panels containing weld centerline cracks. Load-unload, sustained load, and cyclic load tests were performed in air or hydrogen gas, liquid nitrogen, and liquid hydrogen using surface-flawed specimens containing weld centerline cracks. Results were used to evaluate the effectiveness of periodic proof overloads in assuring safe and reliable operation of over-the-road cryogenic dewars. Author

N73-21848*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A POTENTIAL MEANS OF USING ACOUSTIC EMISSION FOR CRACK DETECTION UNDER CYCLIC-LOAD CONDITIONS
Alex Vary and Stanley J. Klima 27 Apr. 1973 11 p refs Presented at 9th Symp. on Nondestructive Eval., San Antonio, 25-27 Apr. 1973
(NASA-TM-X-68228; E-7431) Avail: NTIS HC $3.00 CSCL 20K

A preliminary investigation was conducted to assess the feasibility of monitoring acoustic emission signals from fatigue cracks during cyclic bend tests. Plate specimens of 6A1-4V titanium, 2219-T87 aluminum, and 18-Ni maraging steel were tested with and without crack starter notches. It was found that significant acoustic emission signals could be detected in the frequency range from 100 kHz to 400 kHz. Cracks emanating from starter notches were monitored by the ultrasonic pulse-echo technique and periodically measured by micro-optical examination. Methods used to reduce the effects of extraneous noises (i.e., machine noises, fretting) are described. A frequency spectrum analyzer was used to characterize the emissions and to evaluate methods used to acquire the signals (i.e., transducer location, bandwidth selection). The investigation indicated that it was possible to extract meaningful acoustic emission signals in a cyclic bend machine environment. Author

N73-21849*# Carnegie Inst. of Tech., Pittsburgh, Pa. Dept. of Mechanical Engineering.
ELASTO-PLASTIC BENDING OF CRACKED PLATES, INCLUDING THE EFFECTS OF CRACK CLOSURE Ph.D. Thesis
David Paul Jones Oct. 1972 135 p refs Sponsored in part by AEC
(Grant NGR-39-002-023)
(NASA-CR-112268; SM-83A) Avail: NTIS HC $8.75 CSCL 20K

A capability for solving elasto-plastic plate bending problems is developed using assumptions consistent with Kirchhoff plate theory. Both bending and extensional modes of deformation are admitted with the two modes becoming coupled as yielding proceeds. The material work-hardens and, consistent with the fundamental theory of elasto-plasticity, loading is incremental and local unloading is permitted to occur. Equilibrium solutions are obtained numerically by determination of the stationary point

of a functional which is analogous to the potential strain energy. The stationary value of the functional for each load increment is efficiently obtained through use of the conjugate gradient method (CGM) at modest computer storage requirements. The CGM was modified to take advantage of initial search direction vectors to provide possible reductions in computing time from one load increment to the next. This technique is applied to the problem of a cracked plate subject to remote circular bending. Comparison is drawn between two cases of the bending problem. The first neglects the possibility of crack face interference with bending, and the second includes a kinematic prohibition against the crack face from passing through the symmetry plane. Results are reported which isolate the effects of elasto-plastic flow and crack closure. Author

N73-21850# Ohio State Univ. Research Foundation, Columbus.
[PLASTIC INSTABILITY IN PURE SHEAR] Annual Report
A. K. Chakrabarti, E. N. C. Dalder, D. Hauser, D. L. McGarry, V. J. Russo, and J. W. Spretnak Sep. 1972 28 p refs
(Contract AT(11-1)-2048)
(COO-2048-8) Avail: NTIS

The status of the current program on the various aspects of plastic instability in pure shear and its relationship to notch ductility and, thus, the limit to the load-bearing capacity of a component in a structure or machine is covered. The phases covered are: (1) formulation of a generalized theory of plastic instability and the role of the ideally plastic state; (2) characterization of instability behavior in AISI types 304 and 316 stainless steels at various strain rates, at temperatures up to 1000 F; (3) elucidation of the effect of the stress gradient at the root of a notch on the plastic strain at onset of instability; and (4) the effect of strength level and strain rate on the mode of fracture initiation at a notch in AISI 4340 steel. Author

N73-21851# Oak Ridge National Lab., Tenn.
ENERGY RELEASE INTEGRAL FOR FINITE ELASTIC AND VISCOELASTIC MATERIALS
S. J. Chang and B. Bernstein (Ill. Inst. of Tech., Chicago) 1972 12 p refs Presented at the 6th Intern. Congr. on Rheology, Lyon, France Sponsored by AEC
(CONF-720930-1) Avail: NTIS

The energy release integral of Rice and Cherepanov type is shown to be derivable in a more straightforward way by an energy balance equation which is often used in continuum mechanics. The result is derived under the assumption of large deformation and the material can be inelastic. The integral is applied to the tearing test of a finite viscoelastic material. An equation is established to relate the energy release rate and the average strain concentration along the notch surface. A result was obtained previously for the finite elastic materials. Author

N73-21852# Sandia Labs., Albuquerque, N.Mex.
TACOS: A FINITE ELEMENT COMPUTER PROGRAM FOR THE TRANSIENT ANALYSIS OF CYLINDRICAL OBESE SHELLS
S. E. Benzley Oct. 1972 102 p refs Sponsored by AEC
(SC-RR-72-0454) Avail: NTIS

The TACOS is a FORTRAN computer program that analyzes the dynamic transient response of thick cylindrical shells. Either an infinite cylinder (plane strain) or structural ring (plane stress) condition is treated. The finite element method is used to gain a numerical solution. Detailed calculations including transverse normal stress are performed to obtain the early time response. At later times, when the transverse normal stress is insignificant, a shell theory that excludes transverse normal effects is used for the analysis. Author

N73-21853# McElroy (Ralph) Co., Austin, Tex.
DETECTION AND APPLICATION OF STRESS WAVE M.S. Thesis - Tokyo Univ.
Hajime Hatano [1972] 129 p refs Transl. into ENGLISH from a Japanese thesis Sponsored by AEC
(RFP-Trans-114) Avail: NTIS

The application of stress wave analysis to nondestructive testing was investigated. The dislocation characteristics of metallic solids are discussed along with the results of tensile tests. It is concluded that the dislocation shift is the origin of stress waves. F.O.S.

N73-21854# McElroy (Ralph) Co., Austin, Tex.
FUNDAMENTAL RESEARCH ON STRESS WAVE EMISSION IN MILD STEEL AND ALUMINUM ALLOYS
H. Hatano, N. Niwa, Teruo Kishi, and Ryo Horiuchi [1972] 18 p refs Transl. into ENGLISH from Hihakai Kensa (Japan), v. 21, no. 4, 1972 p 219-225 Sponsored by AEC
(RFP-Trans-104) Avail: NTIS

Stress wave emission in mild steel and aluminum alloys during tensile testing shows various patterns according to the respective materials. Mild steel radiates groups of large emissions with the propagation of Luder's band. Emission signal for commercial pure aluminum reaches a maximum just after yielding and decreases smoothly as strain increases. Under the same experimental condition, a maximum value of the signal is sensitive to grain size. In case of Al Mg alloy, small cyclic fluctuations and intermittant bursts of the emission are observed to be accompanied by serration phenomena. Al Cu Mg alloy scarcely emits waves in the neighborhood of yield stress, and with the increase of deformation the emission attains a maximum. These phenomena are discussed from the viewpoint of strength mechanism in dislocation theory. Author

N73-21855# Defence Research Information Centre, Orpington (England).
NUMERICAL CALCULATION OF THE BOUNDARY PROBLEM FOR NON-SYMMETRICAL DEFORMATION OF STRUCTURALLY ANISOTROPIC SHELLS OF REVOLUTION
A. P. Zindman Jan. 1973 8 p refs Transl. into ENGLISH from Prikl. Mekh., (Kiev) v. 4, 1968 p 121-123
(DRIC-Trans-2996) Avail: NTIS HC $3.00

A finite difference method, carried out with the use of a Ural 2 computer, was applied to the calculation of random shells of revolution for unsymmetrical loading. The computer program makes it possible to investigate closed shells of revolution of variable thickness, strengthened by a system of nonsymmetrical, meridian ribs of variable rigidity. ESRO

N73-21856# Defence Research Information Centre, Orpington (England).
TORSION OF A NONHOMOGENEOUS BAR WITH SECTIONS IN THE SHAPE OF ANNULAR OR CIRCULAR SECTOR
S. G. Lekniskii Dec. 1972 13 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR Mekh. Tverdogo Tela, v. 1, 1971 p 71-75
(DRIC-Trans-2995; BR-30361) Avail: NTIS HC $3.00

The problem of torsion of a bar of constant section in the shape of part of a circular ring or in the form of a circular sector is considered. It is assumed that the bar possesses cylindrical anisotropy and is orthotropic and inhomogeneous. The solution is based on the Saint Venant torsion theory which makes it possible to satisfy the conditions on the lateral surface and end faces. ESRO

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N73-21857 Georgia Inst. of Tech., Atlanta.
AN EXPERIMENTAL INVESTIGATION RELATING TO THE COMBUSTION MECHANISM OF AMMONIUM PERCHLORATE COMPOSITE PROPELLANTS Ph.D. Thesis
Howard Evans Jones 1971 193 p
Avail: Univ. Microfilms Order No. 72-19704

Results are presented of an experimental motion picture study designed to provide observations of composite solid propellant combustion. This adds insight into the combustion mechanism of composite solid propellants, increases and complements the observations of previous quench testing, and provides a background of catalytic effects for use in future experimentation. Two-dimensional sandwiches composed of pressed ammonium

perchlorate sections laminated together with thin layers of four currently used binders—polysulfide, polyurethane, polybutadiene acrylic acid, and carboxy terminated polybutadiene—were burned in a window bomb at pressures up to 3200 psig. High speed motion pictures of the combustion were taken at frame rates up to 4000 pictures per second using magnifications of 1:1 to 4:1 on the film plane. The resulting film was carefully reviewed to provide basic physical characteristics of the combustion.
Dissert. Abstr.

N73-21858 National Lending Library for Science and Technology, Boston Spa (England).
STUDY OF THE THERMODYNAMIC PROPERTIES OF VANADIUM NITRIDE, PART 1
V. A. Kozheurov, V. M. Zhikharev, V. I. Shishkov, and G. V. Gritsishina [1972] 9 p refs Transl. into ENGLISH from Izv. Vyssch. Ucheb. Zaved., Chern. Met. (Moscow), v. 8, 1972 p 10-13 In ENGLISH and RUSSIAN
(NLL-M-21551-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

A description is given of an experimental device for the study of the thermodynamic properties of nonstoichiometric nitrides. A method is presented for the experimental study of vanadium nitride in the temperature range of 1300 to 1650 C, and the pressure range of 0.5 to 760 mm m.c. The results are presented diagrammatically in the form of dependences of the fugacity of dissociation of vanadium nitride on its composition.
Author

N73-21859*# Pennsylvania State Univ., University Park. Mechanical Engineering Dept.
THE INVESTIGATION OF CRITICAL BURNING OF FUEL DROPLETS
C. B. Allison, G. S. Canada, and G. M. Faeth Jan. 1972 48 p refs
(Grant NGR-39-009-077)
(NASA-CR-121112) Avail: NTIS HC $4.50 CSCL 21B

Measurements of burning rate and surface temperatures were made for a number of liquid alcohol and paraffin fuels from porous spheres in air under natural convection conditions. The pressure levels of these experiments ranged up to 100 atm. Due to the high pressures, theoretical models of this process included both low and high pressure versions, the latter allowing for phenomena near the thermodynamic critical point of the liquid. The burning rate predictions of the various theories were similar and found to be in fair agreement with the data. Both theory and experiment indicated an approach to critical burning conditions for methanol and ethanol at pressures in the range 80-100 atm. An experimental apparatus was also constructed and testing is currently in progress on liquid fuel combustion from porous spheres in a forced convection environment that simulates combustion chamber conditions. Measurements have also been made of the liquid strand burning rates and surface temperatures of hydrazine in the pressure range 7-600 psia.
Author

N73-21860# Aerojet Nuclear Systems Co., Sacramento, Calif.
DIGITAL COMPUTER PROGRAMS FOR STEADY-STATE OR TRANSIENT TEMPERATURE ANALYSIS OF PLANE AND AXISYMMETRIC BODIES BY THE FINITE ELEMENT METHOD Engineering Operations Report
L. A. Kimura, E. A. Thomas, and F. Yee 26 May 1972 252 p refs
(N8110R:72-040) Avail: NTIS HC $14.75

The temperature distribution of a complex, two-dimensional body with various boundary conditions, including radiation effects, is analyzed. The body can consist of several different materials. The material property parameters and boundary conditions can be both temperature and time dependent. The numerical procedures and the input instructions for the computer programs which provide the solutions are presented. A completely physical interpretation of the heat transfer equations for a finite element system is provided.
Author

N73-21861*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
RESEARCH ON IGNITION AND COMBUSTION IN OXYGEN SYSTEMS
Paul M. Ordin 1973 37 p refs Presented at the Ann. Meeting of the Compressed Gas Assoc., Ind. Gases and Related Prod. Div. and Comm., Charleston, S. C., 17-18 Apr. 1973
(NASA-TM-X-68223; E-7419) Avail: NTIS HC $4.00 CSCL 21B

The work on ignition and combustion research in oxygen systems under the sponsorship of NASA's Aerospace Safety Research and Data Institute is described. Preliminary results of ignition of nonmetallic materials by electric arc and mechanical impact are presented. Ignition by a resonant process involving repeated shock waves has been demonstrated and some of the results included. In addition, results of studies concerned with ignition due to the rapid rupture of metal films and diaphragms are reviewed. Burning rate studies of three nonmetallic materials in oxygen enriched environments were completed and the results presented. A brief description of these combustion studies under zero gravity is also included. These results are compared to combustion under one gravity.
Author

N73-21862*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF PREMIXING ON NITRIC OXIDE FORMATION
David N. Anderson 1973 14 p refs Proposed for presentation at 75th Natl. Meeting of the Am. Inst. of Chem. Eng., Detroit, Mich., 3-6 June 1973
(NASA-TM-X-68220; E-7418) Avail: NTIS HC $3.00 CSCL 21B

Emissions from a simple 10-cm (4-in.) diameter tube combustor burning a premixed, gaseous propane/air mixture were measured. Inlet conditions included a temperature of 590 K (600 F), pressure of 5.5 atm, and reference velocity of 23 m/s (75 ft/s) for a range of equivalence ratios from the lean limit to slightly richer than stoichiometric. A nitric oxide emission index of 1 g NO2/kg fuel was measured for an equivalence ratio of 0.57.
Author

N73-21863# Sandia Labs., Livermore, Calif.
TURBULENT HEAT TRANSFER AND PRESSURE ON LEADING EDGES OF FINS MOUNTED ON A CONE
H. W. Coleman and E. C. Lemmon Dec. 1972 70 p refs
(Contract AT(29-1)-789)
(SCL-RR-72-0308) Avail: NTIS

As a result of an extensive experimental program, a technique was developed for predicting shock shapes, pressures, and turbulent heat transfer rates on the leading edge of a fin, swept wing, antenna, or similar highly swept protuberance near its intersection with a high velocity vehicle. Comparison of predictions with data indicates good agreement. While pressures in the intersection region are higher than infinite swept cylinder theory predictions, heat transfer rates can be either significantly greater or less than theoretical values depending on local flow conditions and geometry.
Author

N73-21864# California Univ., Berkeley. Lawrence Berkeley Lab.
RADIATIVE TRANSFER IN A DENSE WATER VAPOR ATMOSPHERE
J. A. Coakley, Jr. Sep. 1972 66 p refs
(Contract W-7405-eng-48)
(LBL-1324) Avail: NTIS

An approximate mean absorption coefficient was obtained for the pure rotation spectrum of H2O from the Fourier transform of the molecular dipole autocorrelation function. The correlation function was calculated from a classical description of the molecule's rotation. The expression for the absorption coefficient was parameterized so that the temperature dependence of the coefficient could be obtained. When a comparison was made between the results of these classical calculations of the absorption coefficient and those of quantum mechanics, it was found that the classical values were significantly lower than the quantum mechanical values of the mean absorption coefficient. It is suggested that a correction could be made to the classical method which would improve the agreement between the classical and the quantum mechanical absorption coefficients. It was shown that the results given for the pure rotation spectrum could be generalized to the vibration-rotation bands as well.
Author

N73-21865# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Kernverfahrenstechnik.

INFLUENCE OF HEAT TRANSFER PROCESSES ON FLOW AND MIXING IN THE SEPARATION NOZZLE INVESTIGATED WITH FREE MOLECULAR PRESSURE AND TEMPERATURE PROBES

U. Ehrfeld and W. Ehrfeld Jul. 1972 69 p refs In GERMAN
(KFK-1634) Avail: AEC Depository Libraries

The flow and temperature fields in the separation nozzle as well as the effect of heat transfer between heated nozzle walls and the gas flow on flow profiles and demixing were studied by means of combined measurements with free molecular pressure and temperature probes in He/Ar and He/SF6 gas mixtures. Heat transfer between the heated nozzle walls and the flow has only little effect upon the molecular speed ratio. However, the rate of demixing of the components becomes considerably modified by the heat transfer towards the flow. The separation factor of the two components decreases near the deflection wall and increases in the inner flow regions, since the deflection wall is heated. Heating of the inner nozzle plate increases the separation factor of up to 20% over the total cross section can be maintained. Author (NSA)

N73-21866# Institut Royal Meteorologique de Belgique, Brussels.
ADIABATIC AND ISOBARIC MIXTURE OF HUMID AIR AND WATER OR ICE [MELANGE ADIABATIQUE ET ISOBARIQUE D'AIR HUMIDE ET D'EAU OU DE GLACE]

L. Dufour 1972 24 p refs In FRENCH
(Publ-Ser-B-68) Avail: NTIS HC $3.25

Various temperatures were defined for each adiabatic and isobaric transformation of humid air containing water or ice. They included thermodynamic temperature of the wet or ice-covered thermometer, the thermodynamic equivalent temperature, and isenthalpic dessication evaporation, and condensation temperatures. ESRO

N73-21867# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Antriebssysteme.
EXPERIMENTAL RESEARCH AND DISCOVERY OF EXPONENTIAL LAWS ON THE VARIATION OF TEMPERATURE, VELOCITY, AND CO-CONCENTRATION IN A HOT NITROGEN JET OR A NITROGEN PROPANE FLAME AT ATMOSPHERIC PRESSURE [EXPERIMENTELLE UNTERSUCHUNGEN UND FINDUNG VON POTENZGESETZEN UEBER DEN VERLAUF VON TEMPERATURE, GESCHWINDIGKEIT UND UC-KONZENTRATION IN EINEM STICKSTOFF-HEISSGASSTRAHL BZW. IN EINER STICKSTOFF-PROPAN-FLAMME BEFREIER ATMOSPHAERE]

Michael Kallergis and Rudolf Ferdinand Neubauer 1973 38 p refs In GERMAN; ENGLISH summary
(DLR-FB-73-05) Avail: NTIS HC $4.00 DFVLR, Porz, West Ger. 11 DM

For the simulation of supersonic combustion, using an arc heater, a hot nitrogen jet and a nitrogen propane flame at atmospheric pressure were investigated. From the measured profiles of temperature, total pressure, and CO concentration up to about 2000 K simple exponential functions were derived describing the variation of temperature, velocity, etc. on the jet axis. An extrapolation near the nozzle produces values which are acceptable. Qualitative spectroscopic measurements show that in the case of the nitrogen-propane flame many radicals are formed. ESRO

N73-21868# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Abteilung Heterogene Stroemungen.
AN APPROXIMATE CALCULATION OF LAMINAR INCOMPRESSIBLE BOUNDARY LAYER AND HEAT TRANSFER ON A WAVE-SHAPED WALL

Lutz Reichle and Shinji Hayama (Tokyo Univ.) 1973 29 p refs
(DLR-FB-73-07) Avail: NTIS HC $3.50; DFVLR, Porz, West Ger. 9 DM

A theoretical investigation was carried out on the laminar incompressible boundary layer and heat transfer on a wave-shaped wall. This study is aimed at calculating heat transfer coefficients on a wave-shaped wall. Pohlhausen's method and Dienemann's method were applied calculate boundary layer thickness of velocity and temperature, respectively. Finally heat transfer coefficients on a wave-shaped wall were compared to those on a flat plate. This investigation has been carried out in connection with liquid film cooling of combustion chambers. Author (ESRO)

N73-21869# Institut fuer Chemie der Treibstoffe, Berghausen (West Germany).
SIMULATION OF THE MECHANICAL AND ENVIRONMENTAL STRESSES ON AMMUNITION WITHOUT SHELLS AND WITH COMBUSTIBLE SHELLS [NACHBILDUNG DER MECHANISCHEN UND UMWELTBEDINGTEN BELASTUNGEN HUELSENLOSER MUNITION UND VERBRENNBARER HUELSEN]

D. Schmitt 31 Dec. 1972 58 p refs In GERMAN
(ICT-6/72) Avail: NTIS HC $5.00

Tests have been set up for newly developed ammunition in order to predict mechanical and environmental stresses. The following test methods were proposed for caseless ammunition and ammunition with combustible cases, based on an analysis of the possible stresses: null test, tensile and compression test, relaxation, retardation, dynamic tests, vibration tests, humidity investigations, boil-off tests, and ignition temperature. ESRO

N73-21870# Laboratoire Central de Recherches Thomson-CSF, Orsay (France).
STUDY OF PYROELECTRIC DETECTORS WITH A LARGE RANGE OF OPERATING TEMPERATURE Final Report [ETUDE DE DETECTEURS PYROELECTRIQUES A LARGE DOMAINE DE TEMPERATURE DE FONCTIONNEMENT]

E. Leiba 2 Dec. 1971 11 p In FRENCH
(Contract DRME-70.599)
(LCR-DB-1-71-266/1/R) Avail: NTIS HC $3.00

The development of a pyroelectric temperature detector with an operating range of -40 to +70 C, to be applied to the ignition mechanism of an antivehicle mine, is discussed. The normal TGS crystal target material is limited to temperatures of under +46 C but provides a high low frequency sensitivity of 10 to the 9th power /W cm sq root Hz. In order to improve the temperature range, another crystal made of TGFB (glycol fluoroberyllate) was used in parallel. This crystal provides a sensitivity of 10 to the 8th power /W cm sq root Hz over the temperature range of +45 to +70 C. ESRO

N73-21871# Avco Corp., Wilmington, Mass. Systems Div.
STUDIES OF GRAPHITE VAPORIZATION USING A MODULATED BEAM MASS SPECTROMETER Final Technical Report, 15 Apr. 1971 - 14 Apr. 1972

Warren C. Steele and Frederick N. Bourgelas Wright-Patterson AFB, Ohio AFML Sep. 1972 38 p refs
(Contract F33615-71-C-1509; AF Proj. 7360)
(AD-755899; AVSD-0048-73-CR; AFML-TR-72-222) Avail: NTIS CSCL 16/3

A set of experiments employing a mass spectrometer to study the kinetics and thermodynamics of graphite vaporization is described. Evidence for the existence of small amounts of C10, C11, C14, and C15 in the vapors over hot graphite at about 3000K is presented and discussed. Reflection of C3 vapor by graphite surfaces has been shown to occur without condensation or exchange interaction for surface temperatures in the range 1000K less than Ts less than 2700K. Isotopic labelling has been employed to demonstrate significant exchange between C3 molecules condensed on the surface and atoms from the graphite substrate. A mass spectrum for C3 is presented. Author (GRA)

N73-21872# Army Foreign Science and Technology Center, Charlottesville, Va.
TEMPERATURE FIELD IN A CYLINDRICAL WALL FOR AN ASYMPTOTIC REGIME AND VARIABLE HEAT CONDUCTIVITY COEFFICIENT

N. I. Kalynyak and V. F. Marko 8 Aug. 1972 11 p refs Transl. into ENGLISH from Vychislitelnaya i Prikl. Mat. (USSR), no. 10, 1970
(AD-755251; FSTC-HT-23-690-72) Avail: NTIS CSCL 20/13

The authors give an asymptotic solution to the problem of the temperature distribution in a hollow cylinder under asymptotic regime and variable heat conductivity coefficient by the method of small parameter resolution. Author (GRA)

N73-21873# Naval Ordnance Lab., White Oak, Md.
SHOCK PROPAGATION IN A DECREASING-DENSITY SPHERICALLY SYMMETRIC EXPONENTIAL ATMOSPHERE
Delbert L. Lehto 21 Nov. 1972 22 p refs
(AD-755173; NOLTR-72-275) Avail: NTIS CSCL 19/4

In a previous report the author reported the results of calculations of shock wave propagation in the downward direction (i.e., the direction of increasing density) from an explosion in a spherical exponential isothermal atmosphere. In this report, the corresponding problem is examined for upward shock propagation. A Lagrangian, finite-difference, artificial viscosity computer program (WUNDY) is used to generate the results. Modified Sachs scaling does not work well in the decreasing-density direction. GRA

N73-21874# Fulmer Research Inst., Ltd., Stoke Poges (England).
THERMODYNAMIC INVESTIGATION OF COMPOUNDS IN ROCKET PROPULSION Interim Scientific Report
P. Gross, C. Hayman, and M. C. Stuart 29 Jan. 1973 13 p ref
(Contract F44620-72-C-0039; AF Proj. 9750)
(AD-755894; R.163/48; AFOSR-73-0274TR) Avail: NTIS CSCL 07/4

The calculation of the correction for the heat of evaporation of liquid chlorine into a calorimeter caused by the rise in temperature during the reaction has been improved. This leads to an approximately 0.25 kcal revision to the standard heat of formation of alpha WCl6 as stated in the report AD-748932 . The revised value for the standard heat of formation at 298K for alpha WCl6 is minus 227.18 kcal. The heats of transformation for alpha-1 to alpha-2 and alpha-2 to beta WCl6 were measured. GRA

N73-21875# Army Foreign Science and Technology Center, Charlottesville, Va.
EFFECT OF MASS REMOVAL PRODUCTS ON HEAT EXCHANGE AT GRAPHITE DISINTEGRATION IN A RADIATING AIR PLASMA
A. B. Karasev and T. V. Kondranin Jan. 1973 18 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekh. Zhidk. Gaza (Moscow), 1971
(AD-755784; FSTC-HT-23-1360-72) Avail: NTIS CSCL 16/3

The problem of a stationary hyperacoustic overflow of the leading critical point of a blunt body made of graphite by a high temperature viscose and heat conducting stream of radiating air in the space between the receded shock wave and the body surface is examined. An investigation of radiant and convectional heat exchange on the impenetrable surface was conducted, as well as in the presence of injection blast. Characteristics were obtained of the graphite mass removal with the condition that the radiation transport by the products of its disintegration takes place. Author (GRA)

N73-21876# Aerodyne Research, Inc., Burlington, Mass.
A STUDY OF WIND TUNNEL SIMULATION OF HIGH ALTITUDE ROCKET PLUMES Final Report
James Stark Draper and James P. Moran Feb. 1972 163 p refs
(Contract F04611-72-C-0063)
(AD-755840; AFRPL-TR-72-111) Avail: NTIS CSCL 19/7

A review of several simple, inviscid, high-altitude rocket plume models indicated the most accurate representation. Wind-tunnel plume measurements have been used to verify the Jarvinen-Hill model and to study the plume viscous mixing layers which simulated flight conditions by matching wind tunnel and flight plume Knudsen numbers. The HAPRAP data simulate typical ICBM sustainer flight in the 120 to 320 km altitude range. Author (GRA)

34 GENERAL

Includes information of a broad nature related to industrial applications and technology, and to basic research; defense aspects; information retrieval; management; law and related legal matters; and legislative hearings and documents.

N73-21877 George Washington Univ., Washington, D.C.
IMPROVING COST ESTIMATING AND ANALYSIS IN DOD AND NASA Ph.D. Thesis
Bruce Nelson Baker 1972 193 p
Avail: Univ. Microfilms Order No. 72-19736

A critique of cost estimating techniques and procedures in NASA and DOD is presented emphasizing the major factors contributing to cost overruns. Research interviews were conducted with appropriate government officials to determine personal attitudes toward present and possible future cost estimating techniques. These interviews, in addition to questionnaires, showed that a majority of respondents distrust the parametric approach to cost estimating, but favor detailed engineering methods to reduce overruns. It is pointed out that since the Blue Ribbon Defense Panel urged the adoption of parametric approaches, either a widespread change in the prevailing attitude or a policy revision will be necessary in the near future. Dissert. Abstr.

N73-21878 Laboratorium fuer Betriebsfestigkeit, Darmstadt (West Germany).
[INSTITUTE PUBLICATIONS, REPORT 5, FROM THE LABORATORY FOR SERVICEABILITY CONTROL. OPERATIONAL LIFE AND DURABILITY OF MATERIALS AND STRUCTURES SUBJECTED TO LOADS] [INSTITUTSVEROEFFENTLICHUNGEN, HEFT 5]
Apr. 1972 158 p refs In GERMAN
Copyright. Avail: Issuing Activity

Management, operation, and instrumentation of the institute are briefly outlined and current research projects are discussed. Scientific and experimental work centered on structural damage problems, reliability engineering, quality control measures, and fatigue design procedures for transport vehicles. Transl. by G.G.

N73-21879*# Syracuse Univ., N.Y.
MANNED SPACE FLIGHT IN TRANSITION Final Report
Eugene E. Drucker, William S. Pooler, David L. Wilemon, and Bernard D. Wood Mar. 1973 74 p
(Grant NGR-33-022-139)
(NASA-CR-131931) Avail: NTIS HC $5.75 CSCL 05A

A study was conducted to analyze the reorientation of NASA programs in the post-Apollo period. The study is an external view of NASA by unbiased observers as an input to and aid in the decision making process concerning near and long term planning. The subjects discussed are: (1) the near-term NASA scenario; (2) organization of field centers; (3) planning activities; and (4) operational activities. A summary of the recommendations arising as a result of the study is presented. Author

N73-21880*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ADAPTING THE GODDARD RESEARCH AND ENGINEERING MANAGEMENT EXERCISE (GREMEX) TO NONSPACECRAFT ENVIRONMENTS
Robert O. Wales Washington Apr. 1973 66 p
(NASA-TN-D-7238; G-1080) Avail: NTIS HC $3.00 CSCL 05A

A computerized training aid for all levels of research and development managers is presented. The computer model used for NASA training simulates development of a spacecraft. Operation of the model is described together with instructions for changing the input-data cards to alter the nomenclature and response of the model for use in other training environments. Author

N73-21881# Advisory Group for Aerospace Research and Development, Paris (France).
THE 1972 AGARD ANNUAL MEETING COMMEMORATING AGARD'S TWENTIETH ANNIVERSARY
28 Sep. 1972 112 p In FRENCH and ENGLISH Meeting held at Brussels, 28 Sep. 1972
Avail: NTIS HC $7.75

Proceedings of the AGARD meeting are reported. Belgian research and development programs presented include: some Belgian contributions to aerospace techniques; structures and materials research in Belgium; and fluid dynamic research in Belgium. A lecture on lessons learned and future directions in the management of technical programs was also presented. F.O.S.

N73-21882# National Research Council of Canada, Ottawa (Ontario).
QUARTERLY BULLETIN OF THE DIVISION OF MECHANICAL ENGINEERING AND THE NATIONAL AERONAUTICAL ESTABLISHMENT, 1 OCTOBER - 31 DECEMBER 1972
Dec. 1972 103 p refs
(DME/NAE-1972(4)) Avail: NTIS HC $7.25

Current studies are reported which include the following headings: (1) A description of the NAE T-33 turbulence research aircraft, instrumentation and data analysis; (2) Stationary gas turbine icing problems; (3) The role of plastic deformation in metal powder compaction. D.L.G.

N73-21883# Joint Publications Research Service, Arlington, Va.
SOVIET SCIENCE AFTER FIFTY YEARS
9 Apr. 1973 50 p refs Transl. into ENGLISH from Znanie-Sila (Moscow), no. 12, 1972
(JPRS-58686) Avail: NTIS HC $4.50

Articles are presented on the development of science in the U.S.S.R. with special emphasis placed on the RSFSR, Armenia and Uzbekistan. Author

N73-21884# Joint Publications Research Service, Arlington, Va.
DETERMINING ECONOMIC EFFECTIVENESS OF INDUSTRIAL AUTOMATIC CONTROL SYSTEMS
6 Apr. 1973 9 p Transl. into ENGLISH from Ekon. Gazeta (Moscow), no. 8, Feb. 1973 p 22
(JPRS-58680) Avail: NTIS HC $3.00

The economic effectiveness of planned industrial automatic control systems is discussed in terms of increased labor productivity, optimal reserves of material resources, increased production of goods, and more effective management. Specific methods are recommended for the reduction of industrial costs, as well as for quality improvement measures in a wide variety of industrial parameters. J.M.M.

N73-21885*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
IMPLEMENTING INSTRUCTIONS FOR KSC SYSTEMS AND SAFETY TRAINING
8 Jan. 1973 29 p refs
(NASA-TM-X-69219; KHB-3410.1A/AD) Avail: NTIS HC $3.50 CSCL 05A

The requirements for the safety training program are reported for KSC including transportation, inspection, checkout operations, maintenance of launch vehicles, spacecraft, ground support equipment, and launch teams. The responsibilities and mechanics for implementing the program are outlined. F.O.S.

N73-21886# Joint Publications Research Service, Arlington, Va.
TRANSLATIONS OF EASTERN EUROPE: SCIENTIFIC AFFAIRS, NO.313
17 Apr. 1973 48 p Transl. into ENGLISH from Hungarian and Albanian articles
(JPRS-58769) Avail: NTIS HC $4.50

Conferences on air pollution, paleontology, meteorology, and solid state physics, which were held in east Europe are reported. F.O.S.

N73-21887# Joint Publications Research Service, Arlington, Va.
ROLE OF USSR SCIENTIFIC CENTERS IN ECONOMIC DEVELOPMENT OUTLINED
V. I. Duzhenkov 9 Apr. 1973 15 p Transl. into ENGLISH from Priroda (Moscow), no. 11, 1972 p 2-7
(JPRS-58683) Avail: NTIS HC $3.00

An analysis is presented of the problems of the formation, development and placement of scientific centers and their role in the study and development of the productive forces of the country. Author

N73-21888# Helsinki Univ. (Finland). Radio Lab.
SPACE ACTIVITIES IN FINLAND IN 1972
Martti Tiuti, ed. and Seppo Urpo, ed. 1973 11 p refs
(S-52) Avail: NTIS HC $3.00

The Organization for Space Activities in Finland is briefly described and aspects of its work discussed. These include: ionospheric and magnetospheric research, lunar and meteorite research, satellite geodesy, satellite orbits, remote sensing, applications of space-based technology, satellite tracking, telemetry and acquisition facilities, international cooperation, and publications. ESRO

N73-21889# Laboratoire Central de Recherches Thomson-CSF, Orsay (France).
MULTICRITERIA TABLES. PERTINENCE TREES: DEFINITIONS AND UTILIZATIONS [LES TABLEAUX MULTICRITERES. LES ARBRES DE PERTINENCE: DEFINITIONS. UTILISATIONS]
L. Gerardin Nov. 1971 31 p refs In FRENCH
Avail: NTIS HC $3.75

Techniques in decision making and technological forecasting are reviewed. Particular reference is made to multicriteria tables and relevance trees. The various rational methods described are useful in decision making and in understanding problems more fully. ESRO

N73-21890# Air Force Systems Command, Washington, D.C.
PROCEEDINGS OF AIR FORCE SYSTEMS COMMAND 1972 SCIENCE AND ENGINEERING SYMPOSIUM, VOLUME 1
19 Oct. 1972 549 p refs Conf. held at San Antonio, Tex., 17-19 Oct. 1972
(AD-753071; AFSC-TR-72-005-Vol-1) Avail: NTIS CSCL 05/2

The report is a collection of the unclassified papers presented at the 1972 AFSC Science and Engineering Symposium in San Antonio, Texas. The papers cover a wide variety of technical subjects representing outstanding achievements by AFSC scientists and engineers. Author (GRA)

N73-21891# Weapons Research Establishment, Salisbury (Australia).
[RESEARCH ON RADIO WAVE PROPAGATION, ROCKET ENGINES AND COMPUTERIZED AID] Annual Report, 1971
1972 66 p refs
(PB-213217) Avail: NTIS HC $3.00 CSCL 05B

Research on radio wave propagation, oblique chirp sounding in the ionosphere, and high altitude winds is discussed. Electronic warfare, rocket engines for upper atmospheric research vehicles, and weapon systems are evaluated, along with lasers, undersea warfare, and pyrotechnics. J.A.M.

N73-21892# Army Test and Evaluation Command, Aberdeen Proving Ground, Md.
PHYSICAL CHARACTERISTICS Final Report on Test Operations Procedures
Ardo C. Trede 30 Aug. 1972 33 p Supersedes MTP-2-3-500, MTP-3-3-500, MTP-4-3-500; MTP-5-3-500, MTP-7-3-500, MTP-8-3-500, MTP-9-3-500, MTP-10-3-500
(AD-755626; TOP-1-3-504; MTP-2-3-500; MTP-3-3-500; MTP-4-3-500; MTP-5-3-500; MTP-6-3-500; MTP-7-3-500; MTP-8-3-500; MTP-9-3-500; MTP-10-3-500) Avail: NTIS CSCL 15/5

The report describes a method for evaluation of materiel physical characteristics. It discusses preliminary activities, facilities, and equipment required. It provides procedures for wheeled, tracked, and special purpose vehicles; armament and individual weapons; ammunition and explosives; missile and rocket systems, electronic, avionic, and communications equipment; aviation, air delivery equipment, and aircraft weapons subsystems; chemical and radiological equipment; construction, support, and service equipment; and general supplies and equipment. Author (GRA)

N73-21893# Stanford Research Inst., Menlo Park, Calif.
SUPPORT OF ENVIRONMENTAL PROGRAM PLANNING Final Report
James L. Mackin Oct. 1972 447 p refs
(Contract N00014-72-C-0445; ARPA Order 2195; NR Proj. 089-091; SRI Proj. 1878)
(AD-754784) Avail: NTIS CSCL 13/2

Principal environmental problem areas of importance to the Department of Defense were identified and possible approaches

to advanced research projects directed toward solutions of these problems were suggested to provide partial source material in support of Defense Advanced Research Projects Agency's research program planning. Topics regarding environmental impact analysis, resources management, air quality, water quality, materials handling and disposal, data management and special problems were included. For each topic, information was organized according to statement of the problem, state of the art, present activities and organization, implications for the DOD, and recommendations for further studies. Author (GRA)

N73-21894# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE COMBAT USE AND COMBAT EFFECTIVENESS OF FIGHTER-INTERCEPTORS

V. H. Durov 31 Jul. 1972 301 p refs Transl. into ENGLISH of the Book "Boevoe Primenenie i Boyevaya Effektivnost Istrebiteley-Perekhvatchikov' Moscow, Voyennoye Izd-vo. Min. Oborony SSSR, 1972 p 1-279

(AD-751512; FTD-MT-24-1158-72) Avail: NTIS CSCL 15/3

The methods are dealt with for evaluating the surface guidance and homing of interceptors and rockets, calculation of interception lines and approach trajectories of an interceptor and a target, and determination of the zones of possible attacks and launches, the combat efficiency, and the combat readiness of a single interceptor as well as a group of planes. Modern mathematical methods are used for solving problems of the combat use of fighter-interceptors. The book is intended for specialists in Air Force units, AA aviation, for students at aviation schools, and also for workers in the aviation industry. Author (GRA)

PUBLIC COLLECTIONS OF NASA DOCUMENTS

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